RESTRICTED

Report No. PA-6a

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL DEVELOPMENT ASSOCIATION

KOREA

PYONGTAEK-KUMGANG IRRIGATION PROJECT

March 3, 1969

Agriculture Projects Department

CURRENCY EQUIVALENTS

US$ 1.00	=	Won (W) 280
W 1	=	US$ 0.00357
W 1,000,000	=	US$ 3,570

WEIGHTS AND MEASURES - METRIC SYSTEM

1 hectare (ha)	=	2.47 acres
1 kilometer (km)	=	0.62 miles
1 square kilometer (km^2)	=	0.386 square miles
1 meter (m)	=	39.37 inches
1 cubic meter (m^3)	=	35.31 cubic feet
1 million cubic meters (Mm^3)	=	810.7 acre feet
1 millimeter (mm)	=	0.039 inches
1 square meter (m^2)	=	10.76 square feet

ABBREVIATIONS

LIA	-	Land Improvement Association
MAF	-	Ministry of Agriculture and Forestry
NACF	-	National Agricultural Cooperative Federation
NAPIO	-	National Agricultural Products Inspection Office
ORD	-	Office of Rural Development
SPAD	-	Special Projects Administration Department
ULIA	-	Union of Land Improvement Associations
WFP	-	World Food Program

K O R E A

PYONGTAEK - KUMGANG IRRIGATION PROJECT

TABLE OF CONTENTS

This report is based on the findings of an appraisal mission which consisted of Messrs. J. M. Malone, H. T. Chang, J. C. Douglass, K. Myint and Boonchob Kanchanalak (consultant).

K O R E A

Pyongtaek - Kumgang Irrigation Project

Summary

i. The Government of the Republic of Korea has requested a Bank loan of US$ 45 million to assist the Union of Land Improvement Associations (ULIA), a semi-autonomous government agency, in financing the development under pump lift irrigation of two areas, Pyongtaek and Kumgang, comprising about 37,000 ha located along tidal estuaries near the southwestern coast of the Korean Peninsula (see Map 1). The project is an important part of the Korean Government's All Weather Farming Program within the framework of the Second Five-Year Economic Development Plan, 1967-71.

ii. One of the main objectives of the Second Five-Year Plan is the attainment of self-sufficiency in foodgrains. The Government hopes to achieve this goal through expansion and rehabilitation of irrigation facilities (the All Weather Farming Program); farmland reclamation (both upland and tidal); land reorganization and consolidation; and measures to increase yields. The project, which would benefit about 50,000 farm families, and would combine most of these measures, would involve pumping water from river estuaries into canals to irrigate land in adjacent valleys and on lower slopes. Construction in the Kumgang area would take about three years and that in the Pyongtaek area about five. The project would include the setting up of a new department within ULIA to manage the project; employment of consultants; preparation of final designs; acquisition of rights of way; construction of pumping stations, irrigation and drainage canals, sea dikes, roads, offices, etc.; raising of the operating level of Tapchang reservoir; reclamation of 4,400 ha of tidal flats; consolidation, preparation and levelling of farmland; and procurement of farm tractors and spraying equipment.

iii. The total cost of the project, including interest during construction, would be about W 25.2 billion (US$ 89.9 million). The proposed US$ 45 million loan would cover 50% of the total cost. The remaining 50% would be met by government budget allocations and possibly World Food Program (WFP) assistance to ULIA which would be responsible, with the assistance of consultants, for the execution of the project by contractors. All tendering for procurement and major civil works contracts would be on the basis of international competitive bidding. The exact size of the foreign exchange component would depend on the outcome of the bidding, but would be approximately 40% and no more than 47% of the total cost.

iv. The purpose of the project would be to extend the double cropping of barley and vegetables with rice to as much of the land area as possible through improved drainage and mechanization, while increasing the yields of the existing crops through better water regulation which in turn would permit the use of fertilizer and other purchased inputs.

v. The project would lead to a doubling of net farm incomes and an increase in annual crop production in the project area of more than 200% within three years of the provision of irrigation water, consisting of an additional 81,000 tons of rice, 37,000 tons of barley, 136,000 tons of vegetables and 84,000 tons of fodder, as well as smaller amounts of fruits and other minor crops. The additional grain production resulting from the project would be equivalent to about 10% of Korea's current total grain imports, and would result in annual foreign exchange savings of about US$ 17 million. The project's internal rate of return would be 14%. The project is suitable for a Bank loan of US$ 45 million equivalent with a maturity of 30 years, including 7 years' grace.

REPUBLIC OF KOREA

PYONGTAEK-KUMGANG IRRIGATION PROJECT

I. INTRODUCTION

1.01 The Government of the Republic of Korea has requested a Bank loan of US$ 45.0 million to assist in financing the development under pump-lift irrigation of two areas, Pyongtaek and Kumgang, comprising about 37,000 ha located along tidal estuaries near the southwestern coast of the Korean Peninsula (see Map 1). The project is part of the Korean Government's All-Weather Farming Program within the framework of the Second Five-Year Economic Development Plan, 1967-71.

1.02 One of the main objectives of the Second Five-Year Plan is the attainment of self-sufficiency in foodgrains, from the present position in which 16% of the food grains are imported. The government hopes to achieve this goal through expansion and rehabilitation of irrigation facilities (the All Weather Farming Program); farmland reclamation (both upland and tidal) and soil conservation; land consolidation; and measures to increase yields. The project, which would combine most of these measures, would contribute about 10% of the long-range target for the ultimate expansion of Korea's total irrigated area.

1.03 The loan request was prepared by the Union of Land Improvement Associations (ULIA), a semi-autonomous agency of the Korean Government, with the assistance of the FAO/IBRD Cooperative Programme. This report is based on information submitted by ULIA and on the findings of an appraisal mission which visited the Republic of Korea in September-October, 1968. The mission consisted of Messrs. J.M. Malone, H.T. Chang, J.C. Douglass, K. Myint and Boonchob Kanchanalak (consultant).

II. BACKGROUND

2.01 The Republic of Korea has a population of about 30 million, growing at a rate of 2.4% (1967), and a total land area of less than 100,000 km^2 It consists of the southern half of a rugged, elongated peninsula located in the temperate zone on the Chinese coast, between the Yellow Sea and the Sea of Japan. The mountainous backbone of the peninsula is near the eastern side, sloping more gradually to the south and west, where wide alluvial river valleys provide the country's major agricultural areas.

2.02 Although the agricultural sector provides the livelihood of more than half of Korea's total population it contributes only about 33% of total GDP, and while agricultural production has been growing at an average rate of about 4% annually, the industrial sector has grown about four times as fast. The gap between urban and rural incomes has widened rapidly, so that, in the countryside, the US$ 100 equivalent per capita GNP is well below the national average of US$ 150, and less than half of non-farm per capita GNP.

2.03 Agricultural growth has been achieved by increasingly intensive use of Korea's scarce arable land. A summary of the present pattern of land use is shown below:

	(Million ha)
Full irrigated paddy fields	0.8
Partially irrigated paddy fields	0.3
Rainfed paddy fields	0.2
Subtotal	1.3
Dry fields (upland crops)	1.0
Total cultivated area	2.3
Forest (mostly mountainous)	6.7
Other	0.9
Total land area	9.9

Farming is still basically subsistence-oriented. Average farm size is small, less than one ha of crops per household, but the Korean farmers are progressive and hard-working, and their yields per ha are extremely high. Roughly half of the total cultivated area produces more than one crop each year, as a result of interplanting and double cropping.

2.04 Although Korea's annual precipitation is adequate for agricultural purposes, being well in excess of 1,000 mm in most areas, it is poorly distributed, with more than half occurring as torrential downpours between mid-June and mid-September, the growing season for rice. These peak rainfalls are often interrupted by periods of drought lasting from 10 to 20 days, so that large areas of cropland suffer from either flood or drought damage at fairly regular intervals. Further, due to the country's irregular topography, characterized by a large number of abrupt, fragmented granitic outcroppings, there are few convenient sites for reservoir construction or large contiguous units of irrigable land. As a result, the development of irrigation has occurred mainly in the form of small units, built, owned and operated by farmers' Land Improvement Associations (LIA's), often without any storage facilities, at a relatively high investment per hectare.

The All Weather Farming Program

2.05 Of the half million hectares of paddy fields which are presently rainfed or only partially irrigated, about 350,000 ha are thought to be potentially fully irrigable, although some 70,000 ha of this area would depend on the development of as yet unproven groundwater resources. There are, moreover, about 200,000 ha of potentially reclaimable land on higher slopes and tidal flats, although such lands become progressively more difficult and expensive to develop as the better lands with the best physical conditions are developed first. With the extremely high pressure of population on arable land, at a ratio of about 13 persons per cultivated hectare, and the persistent necessity of importing large quantities of food with scarce foreign exchange, the Government understandably continues to give priority to irrigation and tidal and upland reclamation, in spite of the high investment cost per hectare.

2.06 To complement these measures, the Government is also engaged in programs of land consolidation and agricultural improvement through research, extension and credit. These programs have the dual objectives of (a) further increasing yields per hectare, especially in areas receiving irrigation, by the more widespread use of fertilizer, pest control, improved seeds etc.; and (b) expanding the area of double cropping by consolidating fragmented holdings into compact blocks with improved irrigation and drainage and large enough size to permit mechanization, thereby allowing for the timely establishment and clearing of the second, winter crop.

III. THE PROJECT AREA

3.01 The proposed project would serve two separate land areas, Pyongtaek and Kumgang, located along tidal estuaries near the western coast of Korea, respectively 70 km and 170 km due south of Seoul (see Map 1). These areas fall roughly within 36° and 37° north latitude. They were chosen because they contain fairly large contiguous blocks of irrigable paddy fields near still unutilized sources of water supply and would permit the construction of irrigation systems at a cost which, although high by world standards, would not be unreasonable in the context of the relatively high productivity of Korean agriculture.

3.02 The total gross area covered by the project would be about 60,000 ha, of which, due to the irregular topography, the irrigation systems would command only 37,350 ha, including 4,400 ha to be reclaimed from the sea, and the net irrigated area would be 35,250 ha. The area is distributed as follows: (amounts in ha)

	Pyongtaek	Kumgang	Total
Net irrigable area:			
Tidal flats	4,400	-	4,400
Paddy fields	14,400	13,050	27,450
Lower slopes	1,300	2,100	3,400
Sub-total	20,100	15,150	35,250
Non-irrigable area (poor soils)	1,600	500	2,100
Total command area	21,700	15,650	37,350
Area not commanded	17,900	4,600	22,500
Total gross area	39,600	20,250	59,850

The estimated total population residing within the project area is about 330,000, broken down as follows:

	Pyongtaek	Kumgang	Total
Farm population	130,000	130,000	260,000 1/
Non-farm population	50,000	20,000	70,000
Total	180,000	150,000	330,000

The main towns are Pyongtaek and Kanggyong (on the Kumgang), which are connected by rail and paved road with both Seoul and Pusan, the major port, as well as other major towns outside the project area (see Map 1). Kunsan, at the mouth of the Kumgang, can only accommodate ships of up to 10,000 tons. The project area encompasses a road network of about 1,000 km, mostly all-weather, gravel-surfaced village roads. The area is well-served by both road and rail transport and storage facilities for crops and farm inputs.

Climate

3.03 The Pyongtaek and Kumgang areas have similar climates with about 1,300 mm average annual precipitation and 29°C maximum summer temperature. The hot season is protracted, with a short spring and fall. Sub-zero temperatures, with snow and frozen ground are frequent during winter, so that most agricultural activity is confined to the period March - November. Although most of the precipitation occurs during the growing season, droughts lasting from 10 to 20 days can occur at any time and, together with occasional floods, present the most serious climatic hazard to crop production.

Topography and Soils

3.04 The rock underlying both areas is weathered granite. The terrain consists mainly of alluvial valleys, interspersed with heavily eroded, rolling uplands. In Pyongtaek, the two tidal estuaries associated with the main rivers lie within the project area. The soils fall broadly into two types: the heavy, medium to fine-textured, poorly drained alluvial valley clays (80%) and the coarser, lighter, better drained but more acidic upland soils (20%). With proper management, including the application of fertilizer and lime, most of these soils are capable of producing very high yields of a wide variety of crops, although some 4,700 ha in the lowest lying areas are of such weight and texture that they cannot be drained sufficiently to make them suitable for any crops other than rice.

Water Supply

3.05 Reliable hydrological data for the project area are scarce and estimates of available water supply are based on precipitation and runoff. The estimates are sufficiently accurate to permit the design of irrigation systems for the area. Details are given in Annex 1.

1/ The estimated number of farm families residing in the area is about 50,000.

3.06 Two river systems flow through the Pyongtaek area (see Map 2). In the southern part, the Chinwi Chong and Ansong Chong converge on the town of Pyongtaek, where they form a tidal estuary leading to the Yellow Sea. The catchment area of these rivers covers about 1,600 km^2, the annual run-off is about 66.0 Mm^3 and the estimated peak discharge is about 5,000 m^3/sec. About 15 km to the north is the Nam Yang Estuary, fed by the Paran Chong, with a catchment area of 200 km2, an estimated run-off of 19.0 Mm^3 and a peak discharge of 1,000 m^3/sec. A small part of the water available in these two river systems is already being used to irrigate about 11,000 ha.

3.07 In the Kumgang area, water is supplied to the existing irrigated areas by the Kumgang itself and three of its tributaries: the Nonsan Chong, the Soksong Chong and the Yongdong Chong (see Map 3). The Kumgang, almost 400 km in length, with a catchment area of about 10,000 km^2, is one of Korea's three largest rivers. The average total annual discharge at Kanggyong is estimated to be about 5,000 Mm^3. No major multipurpose projects have yet been developed on the Kumgang. However, 69 small existing irrigation schemes, supplying water for 32,000 ha of land, are located upstream from the project area. In the upper part of the catchment area, it is planned to construct a dam on the Kumgang, 70 km northeast of Chonju at Yong Dam, which will impound 66.0 Mm^3 and divert the run-off from about 900 km^2 through s tunnel to an adjacent river basin west of the Kumgang for power generation and the irrigation of about 15,000 ha.

3.08 In 1942, the Tapchang Reservoir was built on the Nonsan Chong, with a storage capacity of about 2.4 Mm^3. At present, the reservoir is only being used to irrigate an area of about 6,000 ha, which separates the northern and southern parts of the proposed Kumgang irrigation scheme. The reservoir site has further potential for storage and considerable amounts of surplus waters are wasted over the spillway every year.

3.09 An existing scheme of about 3,000 ha, included within the project area, is already receiving partial irrigation from the waters of the Yongdong Chong, supplemented by pumping from the Kumgang through an existing pumping station at Yongdu Ri (See Map 3). However, due to the steep terrain and deforestation of its catchment area, the flow of the Kumgang is flashy and, during periods of low flow and/or high tide, the pumps must shut down due to the movement of salt water upstream from the estuary. Thus, water shortages regularly occur during critical periods of plant growth, and yields are depressed.

3.10 The preliminary designs for the project are based on an estimated peak irrigation water requirement of 1.3 liter/sec/ha. In the Pyongtaek area, there is more than enough water available in the Ansong Chong to irrigate the proposed area of 20,100 ha. In fact, tentative plans already exist for the construction of a 27,000 ha extension to the Pyongtaek scheme to use the rest of the available water. This extension would share some of the facilities proposed for the first phase and could thus be built at a relatively much lower cost per ha.

3.11 In the Kumgang area, the proposed project would just about exhaust the available supply during periods of extremely low flow. In fact, during 20-30 day periods of drought of the sort which occur approximately once in ten years, part of the scheme would suffer slightly from water shortage, due either to the low supply in the river, or to salt water intrusion at the upstream pumping site, requiring a shut-down of the pumps. During these periods, the Tapchang Reservoir would be used to provide the project water requirements. By minor modifications to the reservoir spillway, including the introduction of siphons, the operating level would be raised 1.7 m, giving 9 Mm^3 of additional live storage while improving the reservoir's margin of flood safety. The total crop loss that would otherwise have occurred at such times without irrigation could thus be prevented in even the driest years, and the 80% of the Kumgang scheme to which Tapchang water could be delivered could receive full, continuous supply throughout the drought periods by drawing on the additional storage capacity of the reservoir.

Agriculture

3.12 Pyongtaek and Kumgang have similar land-use patterns. All valley land, whether irrigated or not, is occupied by paddy fields, which, in the narrow sloping valleys between the foothills, are carefully terraced. On the broadside of the ridges, where the slope is gentle, there are upland fields, orchards and village compounds. Further up the hills and on steeper slopes, crops give way to woodlots, mostly pine. The average farm size is about one hectare, most of which typically consists of fragments of paddy land and the remainder, of small upland gardens and orchards. Since land reform following 1949, the vast majority of farmers are owner-cultivators, and land tenure is no longer a constraint on increased production. Land consolidation, which has proven extremely popular and effective on nearby existing irrigation schemes, has not yet been initiated in the project area.

3.13 The present intensity of cropping, disregarding inter- and underplanting, is about 132%, broken down as follows:

Cropped Area		%
Summer and Perennial Crops:	Rice	74
	Soya bean	11
	Vegetables	12
	Orchards and pastures	3
	Subtotal	100
Winter Crops:	Barley	29
	Others	3
	Total	132

With the introduction of time-saving machinery, which enables farmers to prepare their fields within the 10-14 days available between the harvest of

one crop and the planting of the next, double cropping on paddy fields is an increasingly common practice in Korea. Due to the lack of irrigation and drainage of the paddy fields in the project area, however, more than 70% of the winter crop there is grown on the better-drained upland slopes. Thus, given mechanization and improved drainage of the paddy fields, there is considerable potential for the expansion of double cropping in both Pyongtaek and Kumgang.

3.14 The major constraint on the production of summer crops, as indicated in para 3.03 above, is the risk, in the absence of irrigation and drainage, of drought or flood, which not only result in depressed yields or crop damage, but also make the use of fertilizers and other purchased inputs uneconomic. As a consequence, the difference in the average yields of adjacent irrigated and non-irrigated areas is great, even in years of favorable climatic conditions, since farmers in non-irrigated areas are unwilling to risk the necessary investment in purchased inputs on the chance of getting good rains.

3.15 Adequate extension services are provided on a nationwide basis by the Ministry of Agriculture and Forestry (MAF), through its Office of Rural Development (ORD). Agricultural credit and farm inputs are supplied through the semi-autonomous National Agricultural Cooperative Federation (NACF) and its member cooperatives, which operate crop and farm input storage facilities and are also responsible for implementing the Government's foodgrain procurement and price stabilization programs. In areas where LIA's operate irrigation schemes, their staff provides more intensive supporting services to their member farmers, including the supply of inputs and farm machinery, and a higher intensity of farm extension, following the broad technical guidance of the ORD.

3.16 In practically every village there is a small rice mill and, in many villages, an NACF warehouse as well. While most farmers belong to cooperatives, 60% of their surplus is sold direct to rice millers and other private buyers and about 70% of their credit needs are provided by private moneylenders at high rates of interest. This situation is due mainly to the fact that, because of financial limitations, NACF has been unable to expand its operations fast enough to meet the growing demand for its services. The Government has under preparation a request for external assistance in financing an agricultural credit project.

3.17 Further details on agriculture in the project area are given in Annex 2.

IV. THE PROJECT

A. General Description

4.01 The project for which Bank assistance is requested is the development under irrigation of two completely separate and physically independent

land units, Pyongtaek and Kumgang. It also includes the prepration by consultants of an improved seeds multiplication project. The project would involve pumping water from river estuaries into canals to irrigate land in adjacent valleys and on lower slopes. Construction in the Kumgang area would take about three years and that in the Pyongtaek area about five. (See construction schedule, Annex 3). The project would include the setting up of a new department within ULIA to manage the project; employment of consultants; preparation of final designs; acquisition of right of way; construction of pumping stations, irrigation and drainage canals, sea dikes, roads, offices, etc; raising of the operating level of Tapchang reservoir; reclamation of 4,400 ha of tidal flats; the consolidation, preparation and leveling of farm land; and procurement of farm tractors and spraying equipment. The project would be relatively costly in comparison with existing irrigation schemes in Korea, due to the fact that it would involve irregular topography, a large number of pump stations, a much higher degree of land consolidation and levelling, a more highly reticulated irrigation and drainage system and, in the Pyongtaek area, construction of sea dikes. (Further details are given in Annex 3).

Major Project Works

4.02 ULIA's preliminary designs for the project, which were prepared with the assistance of the FAO/IBRD Cooperative Program, would provide a sound basis for the preparation of the final, detailed designs, which would take about a year to complete. At Pyongtaek, the two tidal estuaries within the project area would be closed by the construction of sea dikes, one of which is 30% completed, thereby creating fresh water reservoirs and allowing for the reclamation of 4,400 ha of tidal flats. (See Map 2). These reservoirs would supply water for five self-contained sub-schemes -- four on the banks of the Ansong Chong and a fifth to the north of the Nam Yang Estuary -- which would draw water from the estuaries through electric pumps. In addition to the five large first-stage pump stations, which would serve the 80% of the area with an elevation of 10 m or less, ten smaller second-stage and two third-stage re-lift pump stations would be built to raise the water to higher fields. The irregular topography of the area would call for a complex canal system, with 670 km of canals and 47 short tunnels with a total length of 6.2 km.

4.03 In the Kumgang area, the irrigation system would be based on pumping from three points on the left bank of the Kumgang (see Map 3): two new pump stations would be built at Bongjong and Kanggyong. The latter would be supplemented by the existing pump station at Yongdu Ri. Because of the penetration of salt water upstream of Kanggyong during periods of low river flow and/or high tides, an interconnecting canal system would be required, with Kanggyong at the center, to ensure regular supplies to all parts of the scheme. In addition, the operating level of the existing Tapchang Reservoir would be raised by 1.7 m to give 9 Mm^3 of additional storage capacity, as explained in para 3.11 above. This would be used to supply all but 3,550 ha of the scheme during times of extreme drought, when even the farthest upstream pump station at Bongjong, 50 km from the river's mouth, might be forced to shut down because of salt water intrusion.

4.04 There is little legislation governing water rights in Korea. The use of all river waters, however, is closely controlled by the Ministry of Construction's River Control Office, under the provisions of the River Law (No. 892) of December 27, 1961, as amended. In view of the fact that the water requirements of the Kumgang scheme would almost completely exhaust the uncommitted balance available in the river during periods of extremely low flow firm written assurances have been obtained during negotiations that the government and ULIA would not permit the upstream diversion of any water required for the project at such times.

4.05 In addition to the two first-stage pump stations, seven second-stage pump stations would be built along the main canals. Two diesel-driven 1/ drainage pump stations would be built along the lower reaches of the Soksong Chong to drain an area of 1,000 ha which is regularly flooded. (Two existing drainage pump stations are already operating in the upper reaches). The distribution of irrigation water would require the construction of 550 km of canals and 24 short tunnels with a total length of 5.2 km.

Land Development

4.06 At both Pyongtaek and Kumgang, the distribution system would supply water through turnouts to irrigation units of approximately five hectares each. Within these units, individual farmers' fragmented fields would be consolidated; and uniform, contiguous blocks of levelled land, each served by an irrigation ditch, a drainage ditch and a simple farm access road built on the bank of the irrigation ditch, would be reallocated to the farmers. In the higher parts of the command areas, this consolidation would have to be accompanied by terracing of the individual blocks, as a prerequisite to irrigation development. This type of land consolidation and development, which is already extremely popular with Korean farmers, would allow for controlled water supply, improved field drainage and mechanization, thereby making double cropping feasible on a much larger area than at present.

Crop Development

4.07 The central purpose of the project would be to extend the double cropping of barley and vegetables with rice to as much of the land area as possible through improved drainage and mechanization, while increasing the yields of the existing crops through better regulation of the crop water supply, which in turn would permit the use of fertilizer and other purchased inputs. After the completion of the project, rice monoculture would continue on only 4,700 ha of the heaviest soils as against 18,600 ha at present.

4.08 Exploitation of the full potential for double cropping, provided by land consolidation and the establishment of irrigation and drainage facilities,

---

1/ Due to their remote location and the fact that they would only be operated during flood periods, these pump stations could be operated more economically with diesel power than with electric power.

would entail a number of concurrent changes in other farming practices. With this in view, provision is made for an increased extension effort in the proposed organizational set-up for the project's subsequent operation annd maintenance (see para 5.09), and the adoption of such changes in practices is assumed in calculating the project's economic benefits. Farmers would themselves purchase the requisite inputs, with the exception of tractors and spraying equipment, which would be owned and operated by the project organization on a self-liquidating custom-hire basis. In order to facilitate the purchase of the necessary inputs, assurances have been obtained during negotiations that the government, acting through the NACF, would give priority to the project area in the supply of inputs and the allocation of credit funds, and that an annual plan for the physical distribution of the inputs and the provision of the corresponding amounts of credit would be agreed between ULIA, NACF and the government.

Power Supply

4.09 The government-controlled Korean Electric Company would supply the necessary power for the pump stations at an average cost of about 1 1/2 US cents per kwh. The necessary investment in additional transmission and distribution facilities to serve the project, estimated at about US$ 2 million equivalent, would be met by the government out of the national Rural Electrification Fund. This investment would be fully amortized out of the energy charges paid by the project during its life and no provision is made for it in the project cost estimates. Assurances have been obtained during negotiations, however, that the government would construct the necessary facilities promptly and would at all times guarantee to supply the full power requirements of the project.

Improved Seeds Project Preparation

4.10 One of the prospective bottlenecks in the development of Korean farming is that the present system of seed multiplication and distribution may not be adequate to meet the long-run requirements of a growing and more complex agriculture. The existing improved seeds breeding and multiplication scheme needs to be strengthened and enlarged within a legal framework permitting adequate control and certification. It is, therefore, proposed that, as an integral part of the present project, consultants would be employed to:

- review the present situation and make recommendations on future strategy;
- draw up revised legislation for control of a seeds industry; and
- prepare an investment project for seed multiplication and distribution centred around modern seeds processing plants.

With the information already available, particularly from an FAO/IBRD Cooperative Program project identification mission report, a team of about six consultants should be able to complete these tasks within about six months. One question which would require their close attention is whether it would be possible to concentrate seed multiplication in one or two locations, or whether the wide range of growing conditions in Korea would dictate a wider range of locations.

B. Cost Estimates

4.11 The total cost of the project would be W 25.2 billion (US$ 89.9 million) equivalent, made up as follows:

	Local	Foreign	Total	Local	Foreign	Total
	---- Won Millions ---			---- US$ Millions --- 1/		
Engineering Works						
Seadykes	2,060	1,317	3,377	7.4	4.7	12.1
Spillways	937	920	1,857	3.3	3.3	6.6
Distribution System:						
Canals	1,201	510	1,711	4.3	1.8	6.1
Tunnels	182	215	397	.6	.8	1.4
Structures	1,488	1,582	3,070	5.3	5.7	11.0
Pumphouses	237	707	944	.8	2.5	3.4
Drainage	85	40	125	.3	.1	.4
Land Preparation 2/	307	113	420	1.1	.4	1.5
Land Consolidation and Levelling	1,284	954	2,238	4.6	3.4	8.0
Raising Level of Tapchang Reservoir	21	45	66	.1	.2	.2
Acquisition of Right of Way	688	-	688	2.5	-	2.5
Construction of Buildings	31	-	31	.1	-	.1
Approach Road and Communications	74	21	95	.3	.1	.3
Miscellaneous	862	640	1,502	3.1	2.3	5.4
Total Engineering Works	9,457	7,064	16,521	33.8	25.2	59.0
Admin. Design and Supervision (10%)	945	707	1,652	3.4	2.5	5.9
Subtotal	10,402	7,771	18,173	37.2	27.7	64.9
Farm Machinery, Vehicles and Hydrological Equipment	-	520	520	-	1.9	1.9
Total Excluding Contingencies	10,402	8,291	18,693	37.2	29.6	66.8
Contingencies (20%)	2,080	1,659	3,739	7.4	5.9	13.3
Total Including Contingencies	12,482	9,950	22,432	44.6	35.5	80.1
Operation & Maintenance During Const.	928	86	1,014	3.3	.3	3.6
Subtotal	13,410	10,036	23,446	47.9	35.8	83.7
Seeds Project Preparation	7	41	48	-3/	.2	.2
Interest During Construction	-	1,680	1,680	-	6.0	6.0
Grand Total Project Cost	13,417	11,757	25,174	47.9	42.0	89.9

1/ Columns and rows do not necessarily add correctly due to rounding.
2/ Includes clearing, terracing and benching of upland fields before provision of irrigation and drainage.
3/ Less than $50,000.

The cost estimates are based on preliminary designs prepared by ULIA. Unit costs are based on current prices and wages. The estimates for major structures contain design contingencies to cover variations in quantities pending final design. The component of the project which would be subject to international competitive bidding, totalling about US$ 65 million in cost, includes goods and services costing roughly US$ 15 million 1/ which could result in either local or foreign currency expenditure. Thus, while the exact foreign exchange cost cannot be estimated, but would depend on the results of international competitive bidding, it will probably be approximately 40% of total cost and is unlikely to exceed 47% (US$ 42 million), the estimate based on 100% foreign procurement and contracting for all items subject to international bidding. Contingencies of 20% on all items have been added for unforeseen expenditures and possible price increases. The cost estimates also include adequate allowances for engineering, supervision, operation, maintenance and interest during the five-year construction period. The cost estimates are reasonable. Further details of project costs are given in Annex 4.

C. Financing

4.12 The amount of the proposed loan would be US$ 45.0 million (W 12.6 billion) equivalent. The proposed loan would cover approximately 50% of the total cost. The borrower would be ULIA. The remainder of the cost would be met by budget allocations from the government to ULIA and, possibly, from World Food Program (WFP) assistance. The Korean Cabinet has recently approved a draft request for WFP assistance for the project amounting to 93,000 tons of foodgrain and flour (worth about US$ 12 million). In any case, the newly adjusted Second Five-Year Plan, as prepared by the Economic Planning Board and approved by the government, provides adequate government funds for the project. The budget allocation for investments in the expansion and rehabilitation of irrigation facilities (the All Weather Farming Program) amounts to W 2.3 billion (US$ 8.2 million equivalent) in 1968 and to about W 4.9 billion (US$ 17.5 million equivalent) in the draft budget for 1969. The approximate project expenditure schedule, including disbursement of the proposed Bank loan, would be as follows:

Year	1	2	3	4	5	Total
	W billion equivalent					
Government contribution	0.9	3.4	4.1	2.4	1.8	12.6
Bank loan	0.5	3.0	4.0	2.6	2.5	12.6
TOTAL	1.4	6.4	8.1	5.0	4.3	25.2
(US$ million equivalent)	(5.0)	(22.8)	(28.9)	(17.9)	(15.3)	(89.9)

1/ Machinery and equipment which could possibly be supplied by Korean manufacturers (about US$ 10 million) and some civil works contractors' overheads and profits (about US$ 5 million).

D. Disbursement

4.13 About US$ 16 million equivalent of the proposed loan would cover, against full documentation, the cost, including contingencies, of pumps; electrical and mechanical equipment for the sluice gates; cement; steel; timber; O & M and farm equipment, overseas fellowships and the foreign exchange cost of the supervising consultants and the consultants preparing the seed project (see list in Annex 5). Disbursements would also be made on a percentage basis against certificates of expenditure under civil works contracts. The supervising consultants would be responsible for certifying such expenditure, totalling about US$ 56 million equivalent, including contingencies, of which about US$ 23 million, or 41%, would be covered by disbursements from the loan. About US$ 6 million of the proposed loan would finance interest during construction.

E. Procurement

4.14 All tendering for procurement and civil works contracts would be on the basis of international competitive bidding, except for small contracts for terracing, benching and land levelling, totalling about US$ 10 million equivalent, which would not attract serious international competition and would be tendered locally. Even under international bidding, however, it is likely that many of the successful bidders would be Korean, since Korea has both a rapidly developing industrial sector and a large, highly competitive contracting industry. Due to the competitive ability of the local industry, no preference would need to be given to domestic suppliers in evaluating the bids. The project consultants (see para 5.10) would assist ULIA in the preparation of specifications, tender documents and contract forms and in the evaluation of bids.

V. ORGANIZATION AND MANAGEMENT

5.01 The implementation of the project would be the responsibility of the Union of Land Improvement Associations (ULIA), a semi-autonomous public organization within the Ministry of Agriculture and Forestry, whose other responsibilities include:

- the supervision, guidance and audit of the operations of its 272 member associations;
- the planning, financing and supervision of the construction of irrigation and reclamation projects on behalf of the Government or member associations;
- the rental of construction equipment to contractors or member associations for such projects;
- the supply of farm inputs and machinery on credit to member associations;

- the provision of agricultural extension services to member associations; and

- other activities entrusted to it by the Minister (including at present the multiplication of improved rice seed on a nation-wide scale).

ULIA was founded in 1940 as the Union of Chosun Irrigation Associations.

5.02 Through its member associations ULIA controls an area of 325,00 ha, or roughly 43% of Korea's total irrigated area. Most of the new investment in irrigation and reclamation projects is channelled through ULIA and its members as a combination of government grants and government-guaranteed 35-year loans at 3.5% interest. In 1967, the Government provided a total of W 2.8 billion (US$ 10.2 million) in grants and W1.3 billion (US$ 4.7 million) in long-term loans. A further W 3.1 billion (US$ 11.3 million) was provided by the member associations (mostly in the form of labor by farmers during the off-season) for maintenance of canals, etc., to make the total expenditure on irrigation and reclamation during the year about W 7.2 billion (US$ 26.2 million).

5.03 Under ULIA's guidance and supervision, approximately a hundred small-scale reservoir and pump-lift irrigation projects were completed during 1963-1967, serving an area of about 43,000 ha. In addition, 3,000 ha of tidal flats were successfully reclaimed by dike construction. A large number of small fragmented areas were irrigated by the construction of stream diversions and ponds, and considerable efforts and attention were given to upland reclamation, land consolidation and investigations for new projects, including the Bank project. Also, acting on behalf of the Government, ULIA itself has completed forty groundwater development projects covering about 4,700 ha in drought-stricken areas since 1965 and currently has three large tidal reclamation schemes under construction, totalling about 13,000 ha in area. One of these, the large Dongjin Gang Project, covering about 9,000 ha, is nearing completion.

5.04 ULIA's staff of more than 1,200 employees, which includes 558 university graduates, operates from a head office in Seoul (which also serves Kyonggi Province) and eight provincial offices. In addition, about 3,000 people, including some 500 engineers and 600 agronomists, are employed by ULIA's member associations. ULIA's staff is competent and experienced and has amply demonstrated its ability to take on larger, more demanding projects, with the assistance of consultants in final design and supervision (para 5.10).

5.05 ULIA's annual budget is almost totally dependent on government appropriations, either as grants or loans. As of December 31, 1967, ULIA's total assets were W 10.9 billion (US$ 39 million), of which W 8.4 billion (US$ 30 million) consisted of subloans to member associations. (ULIA's financial statements are given in Annex 6). Under existing legislation, all funds lent by the government to ULIA must first be channelled through the NACF, which charges interest for its services as channel of funds. The funds are then relent by ULIA to its members, who retain title to the irrigation facilities constructed with the help of the loan. Repayments to the government must pass through the same indirect channel. In order to eliminate this

three-stage relending and simplify the financing of the Bank project, the government has requested that the proposed Bank loan be made directly to ULIA, who would retain title to the project facilities until the loan had been completely repayed, when title would pass to member associations to be established in the project area. Water charges would be collected from the farmers to cover the cost of operation and maintenance and part of the debt service on the proposed Bank loan. The Government would guarantee to provide, promptly as needed, any remaining balance required to make the semi-annual payments of interest and principal on the proposed Bank loan.

5.06 Headed by a president, a vice president and a board of directors, ULIA is divided into four departments (engineering, construction, agricultural extension, and administration); an engineering and soils laboratory; a heavy equipment shop and a controller's office. Four-year appointments to the offices of President and Vice President are made by the President of Korea upon request of the Minister of Agriculture and Forestry. The directors and other officers of ULIA are appointed by ULIA's president.

Project Management

5.07 As part of the Bank project (see para 4.01 above), a new department would be formed, headed by an experienced, qualified engineer and under the supervision of one of ULIA's directors. Assurances have been obtained during negotiations that no appointments would be made to the posts of director responsible for, or department head in charge of, the new department without prior consultation with the Bank.

5.08 The new department, which would be known as the Special Projects Administration Department (SPAD), would be staffed mainly by transfers from existing departments of ULIA, but some staff, especially economic, financial and agricultural staff, would have to be recruited or seconded from other agencies.

5.09 The SPAD would be made up of six sections as follows: (see organization chart).

(a) The planning and design section, which would be required for only one year, would be set up by transferring from ULIA's engineering department the existing section which prepared the preliminary design of the project.

(b) The construction section would be set up in the second year, incorporating the planning and design section. It would be responsible, with the assistance of the project consultants, for supervising the work of the contractors through a number of field offices to be set up at each major construction site.

(c) The land consolidation section would be responsible for survey and detailed planning of the consolidated irrigation units, preparation of tender documents and supervision of the work.

(d) The operation, maintenance and extension section and its two field offices would be headed by irrigation agronomists who would ensure the coordination of the operation of the irrigation systems with the agricultural needs of the project areas, while providing a high level of extension to the farmers. It would be set up in the third year.

(e) The economics section would be responsible for assessing the economic implications of the project, conducting farm surveys, forecasting the demand for farm credit and maintaining consistency between the cropping pattern and market possibilities.

(f) The administration section would be concerned with the day-to-day administration, financing and accounting of the project.

After completion of the project, the SPAD could carry out further large irrigation projects under the All Weather Farming Program, leaving the other departments of ULIA to handle the normal business of smaller scale projects.

Supervising Consultants

5.10 While ULIA has in the past been responsible for the implementation or supervision of some fairly large projects, and while the development of 37,000 ha over a five-year period is well within the overall capacity which ULIA has built up in recent years, the project would be by far the largest single undertaking in ULIA's history, and would present a number of engineering and construction problems with which ULIA's past experience is somewhat limited. Moreover, ULIA has recently had some difficulty in the financing and execution of groundwater development in the drought areas where, as a result of inadequate supervision and personal indiscretion on the part of a former ULIA officer, serious over-spending and financial leakages occurred. As a condition of effectiveness of the proposed loan, therefore, ULIA would appoint, for the duration of the construction period, supervising consultants acceptable to the Bank.

5.11 The supervising consultants would be employed on terms and conditions acceptable to the Bank. They would be responsible directly to the president of ULIA and would assist ULIA in:

- review of the basic hydrological data and the existing preliminary design;
- supervision of the final design;
- supervision of the construction of the project and certification of payments to contractors;
- preparation of specifications, tender documents and contract forms;
- prequalification of bidders, evaluation of bids and recommendation of awards;

- supervision of testing and analysis of permanent equipment and materials;

- preparation of quarterly and annual progress reports;

- establishment of methods, procedures and regulations for irrigation operation and maintenance and agricultural experimentation and extension;

- establishment of the economic staff;

- selection and training of new recruits to the SPAD; and

- setting up project accounts.

To carry out these tasks, the consultants would have to provide expertise in engineering design and construction; economic analysis and accounting; irrigation operation and maintenance; agricultural engineering and crop husbandry.

Consultants for seeds project preparation

5.12 The consultants who would prepare an investment project for improved seeds multiplication and distribution (see para 4.10) would be responsible directly to the president of ULIA, and would be employed on terms and conditions acceptable to the Bank. The special machinery to be set up for coordination of the irrigation part of the project (see para 5.13) would also be used for coordination of the consultants' activities which must necessarily touch upon responsibilities for seed production presently undertaken (and probably to continue to be undertaken) by the following entities, all under the general jurisdiction of the Ministry of Agriculture and Forestry:

- ORD: plant breeding and selection: breeder and stock seed production: extension for seed production;

- National Agricultural Products Inspection Office (NAPIO): administration of seed law: field inspection, certification and laboratory analysis;

- NACF: credit to seed growers: distribution of certified seed to end-users: marketing of ultimate produce.

Special Coordinating Machinery

5.13 In order to ensure the necessary degree of coordination between ULIA and the other cooperating agencies, particularly the ORD and the NACF, assurances have been obtained during negotiations that a special coordinating committee would be established under the chairmanship of the Vice Minister of Agriculture and Forestry, consisting of senior level representatives of ULIA, NACF, ORD and MAF, and - where the preparation of the improved seeds

project is concerned - NAPIO. In addition to extraordinary meetings, which could be convened at the request of any member to discuss any problem which might arise during the implementation of the project, the committee would meet periodically to review plans for the supply of farm inputs and credit to the project area and reports on the progress of the project before their submission to the Bank.

Training

5.14 Korea is generally well endowed with qualified professional personnel, but not in the field of irrigation agronomy, where the disciplines of engineering and agriculture merge. Nine short-term fellowships, to be organized with the help of the consultants, are provided for under the project, therefore, of which five would be awarded to engineers who need training in agronomy; two would be awarded in seadike construction and two would be awarded to the Chief Project Agronomist and his deputy to give them additional specialized training in irrigation, crop husbandry and mechanization. These fellowships would be timed to meet the requirements of the project as it developed. Additional in-service training of a more informal nature would be provided by the project consultants in connection with their supervision of the project.

Accounts and Audit

5.15 ULIA is not presently subject to any regular external financial audit. Therefore, and particularly in view of the recent difficulty resulting in the overspending of funds allocated for groundwater development, it would be necessary to obtain an independent outside audit of all expenditure under the proposed project. For this purpose, assurances have been obtained during negotiations that ULIA would establish, with the assistance of the supervising consultants, appropriate separate project accounts under the SPAD which would be audited annually by an independent auditor acceptable to the Bank.

The Cost of Operation and Maintenance

5.16 The project cost estimates include the full cost of operation and maintenance during the 5-year construction period. This cost would be incurred mainly by the Operation, Maintenance and Extension section of the new Special Projects Administration Department. ULIA's other costs incidental to the project would be covered by the engineering, supervision and overhead allowances. After the completion of the Pyongtaek system in Year 5, the annual cost of operation and maintenance for the project as a whole would probably continue at a level of about W 0.5 billion (US$ 1.9 million) or about US$ 50 equivalent per ha, including an allowance for the depreciation of capital investments such as pumping equipment. This figure is broken down as follows:

	W Million	US$'.000 Equivalent
Wages and Salaries	21	75
Operation and Maintenance of Irrigation system:		
Pumping Cost 1/	130	464
Distribution System	74	264
Seadikes and spillways	121	432
Administration	40	142
Agricultural Extension	30	107
Maintenance of Vehicles	8	29
Subtotal	424	1513 2/
Contingencies (20%)	84	300
Depreciation allowance:		
Pumps	17	61
Vehicles	5	18
Total	530	1893 2/

1/ Running cost, maintenance and wages of pump station staff.
2/ Inconsistent with Won total due to rounding.

Water Charges

5.17 Under the provisions of the Land Improvement Act (Law No. 948) of 1961, and related Presidential decrees, Korean farmers belonging to a LIA pay not only the full costs of irrigation operation and maintenance (including the agricultural extension services provided by the LIA) but also the unsubsidized 40% portion of capital costs, with interest at 3.5%, over 35 years. Recovery of these costs is achieved through a charge which is levied against the area of irrigated land owned by each farmer, based on 40% of the original capital cost of providing irrigation supply to that land plus the actual current cost of O&M. Thus, other things being equal, farmers benefiting from newer projects, with a higher investment cost per hectare, partially due to inflation, pay a much higher rate than farmers receiving water from the older irrigation systems. The nationwide average rate is about W 10,000 per ha, (US$ 35.70/ha) with rates in individual projects ranging up to about W 20,000 per ha (US$ 71.42/ha). Due to the fact that the proposed project would involve a relatively high investment cost per hectare, as explained above in para 4.01, the comparable water charge for Pyongtaek and Kumgang would be W 30,000 per ha (approx. US$ 107 per ha). This is equivalent to one-third of the incremental farm income before water charges expected at full development (see para 6.08).

5.18 If ULIA collected water charges of W 30,000 per ha in the project area, i.e., charges based on the level of subsidy presently established by presidential decree, it would recover about W 0.5 billion (US$ 1.8 million) a year over and above estimated O&M costs. This would cover almost of the US$ 3.9 million annual debt service on the proposed Bank loan, leaving only US$ 2.1 million a year to be provided by the government. Assurances have been obtained during negotiations that, upon completion of the irrigation systems in Pyongtaek and Kumgang, water charges would be established, in consultation with the Bank, at levels which would permit the recovery of the full O&M costs and a substantial portion (at least the present 40%) of the capital investment over 35 years. In considering the possibility of recovering more than 40% of the investment, care would have to be taken not to impose an undue financial burden on the farmers, or remove the economic incentive to intensify their production.

VI. PRODUCTION, MARKET PROSPECTS & FARM INCOME

A. Production

6.01 The project would lead to an expansion of the cropped area, particularly the double-cropped area, as well as a change in the cropping pattern, as shown below:

	Existing	Projected
	'000 hectares	
Summer and Perennial Crops		
Rice	21.2	32.0
Soybeans	3.2	0.6
Vegetables	3.2	2.1
Orchards and pastures	0.6	3.4
Subtotal	28.2	38.1
Winter Crops		
Barley	8.2	21.0
Vegetables, Fodder, etc	0.9	9.0
Subtotal	9.1	30.0
Total for all crops:	37.3	68.1
Cropping Intensity	132%	182%

The provision of irrigation, and the use of other complementary inputs which would become economic as soon as water became available, would lead within three years of the provision of irrigation water to an approximate doubling of average yields over levels currently obtained in the project area without irrigation. These yields, and the resulting production increases are shown below: (For details, see Annex 7).

	Approximate Average Yields		Total Production		
	Present	Projected	Present	Projected	Increase
	----- m tons/ha -----		--------- '000 metric tons ------		
Rice (white)	2.0	4.0	46	127	81
Barley	1.5	2.5	11	49	38
Other Crops	6.5	20.0	53	299	246

B. Market Prospects

6.02 The output of the project would be almost entirely destined for the domestic market to replace imports and meet increases in demand. Market prospects for the increased agricultural output resulting from the project appear promising. (Details are given in Annex 8). With the projected income and population increases, the domestic market is expected to take increasing quantities of all agricultural products. Demand for commodities such as fruits and vegetables (with high income elasticities) is likely to increase rapidly. The market for rice, which is a deficit commodity and high status food, appears good. The market for barley as a food product is likely to decline, but its prospects as a livestock feed appear promising.

6.03 The NACF provides facilities for the marketing of surplus barley, fruits, vegetables, flax and sweet potatoes in the project area. In addition, farm families would themselves constitute a sizable market for the expected increase in production of other farmers in the area.

C. Prices

6.04 In the valuation of the agricultural output of the project area, farm gate or ex-mill prices have been used. For most crops, the prices used are an average for the period 1964-67 and can be considered reasonably conservative in view of a persistant upward trend in recent years. They are also generally in line with world market prices. Downward adjustments have been made, however, in the prices of rice, barley and soybeans, which were not in line with projected future world market prices.

6.05 For rice a price of US$ 150 (42,000 won) per metric ton has been used in this report instead of the recently announced official price of 52,000 won per metric ton. The price used in this report is also below current world prices 1/, which have increased sharply because of rising world demand for rice coupled with poor harvests in Thailand, Burma and Viet-Nam. A reasonable long-term world average, in terms of Bangkok 5% broken, would be about US$ 140 per metric, cif Pusan. Bangkok 5% broken rice, however, is of a quality inferior to Korean rice, which in the past has even enjoyed a premium of US$ 4-6 per ton above the price of Taiwan rice. The price used in this report, which is about 14% below the prevailing support price, is therefore a reasonable estimate of the long-term future rice price behavior in Korea.

1/ An average of US$ 209 per metric ton, fob Bangkok (5% broken), for the period January to September 1968.

6.06 The barley price in Korea has remained above the world market price for some years. Currently it is about 65% higher than the price of barley, cif European ports. This may be due to the fact that barley is consumed primarily as human food in Korea, and not as livestock feed as in most other countries of the world. In this report a price of US$ 60 (17,000 won) per metric ton has been used. This is in line with projected long-run average world market price of US$ 56, cif European ports. The reason for pricing barley at livestock feed prices is that, with rising incomes, human consumption of barley is unlikely to keep pace with population growth, so that any significant increase in production is instead likely to be of more importance in relation to livestock development. For soybeans, a price of US$ 100 (28,000 won) per metric ton has been used in this report in order to bring it down in line with projected long-run average price of US$ 90, cif European ports.

6.07 Given the acreage, yield and price assumptions mentioned above, the gross annual production value of the project area is expected to increase from the present level of 2.7 billion won (US$ 9.5 million) to 9.1 billion won (US$ 32.5 million) annually at full development, which is expected to be reached within eight years of the start of the project.

D. Farm Incomes

6.08 The potential benefits obtainable under the project, at full development, would provide considerable incentive for farmers. The expected increase in income from a single hectare, growing rice and barley in rotation, which is the most common rotation anticipated, may be summaried as follows:

	Before Development		At Full Development	
	W 000	US$ Equivalent	W 000	US$ Equivalent
Gross value of production	99.3	355	215.5	770
Less produce consumed on the farm	44.0	157	50.0	179
Gross cash income	55.3	198 1/	165.5	591
Cash production costs	28.9	103	47.3 2/	169
Net cash income before project charges	26.4	95 1/	118.2	422
Charges:				
Water: (O & M)	-	-	15.0	54
(Debt Service)	-	-	15.0	54
Taxes	3.1	11	3.2	11
Net Cash Income	23.3	84 1/	85.0	303 1/

1/ Inconsistencies due to rounding

2/ Including custom charges of 16,600 for mechanized cultivation and spraying.

This would mean more than a trebling of net cash income and a doubling of total net income, including subsistence.

VII. BENEFITS AND JUSTIFICATION

7.01 The major quantifiable benefit to be derived from the project would be the substantial increase of agricultural production and farm incomes described above. This would result from the provision of irrigation and other facilities enabling farmers to increase both their cropped area and their yields per hectare. The additional output resulting from the project would consist of 81,000 tons of rice, 37,000 tons of barley, 136,000 tons of vegetables and 84,000 tons of fodder, in addition to smaller amounts of fruits and other minor crops. The additional grain production resulting from the project would be equivalent to about 10% of Korea's total grain imports in 1968. The project would thus contribute substantially towards closing Korea's food grain deficit and contributing to her balance of payments position through annual savings in grain imports estimated at about US$ 17 million.

7.02 At full development, the annual gross value of production from the project area is expected to reach about W 9 billion (over US$ 30 million), more than triple the present level. After deducting production costs, the net value of agricultural production at full development would reach W 6.3 billion (US$ 22.5 million) of which more than two-thirds would consist of the value of rice and barley. This net production would represent a direct benefit to the economy of about W 4.2 billion (US$ 15 million) after deducting project operation and maintenance costs.

7.03 In calculating the project's internal rate of return to the economy, it was assumed that the project would have a useful life of 60 years based on the expected useful life of the seadikes, canals and structures, during which time it would be necessary to replace the pumping equipment once (at the end of 30 years) and vehicles every 5 years. On this basis the project would have an overall rate of return of about 14% with individual rates of 13% for Pyongtaek and 15% for Kumgang. (See Annex 9) In view of the conservative prices used in valuing the benefits, and bearing in mind the project's relatively high cost per hectare, these rates of return should be considered acceptable.

7.04 The analysis above does not take into account any indirect benefits of the project, such as the impact on the attitudes of farmers which would be achieved by the high level of extension services, the degree of land consolidation and the introduction of mechanization to be provided under the project. Nor does it take into account the benefits which would accrue to ULIA as a result of its reorganization and the forthcoming training of its staff through overseas fellowships and the services of the project consultants. Similarly, no account has been taken of the additional benefits likely to accrue from the eventual establishment of an improved seeds project, of which the costs of preparation have been included in project costs. Finally, no account has been taken of the improvement of domestic and industrial water supply in the Pyongtaek area which would result from the project.

VIII. CONCLUSIONS AND RECOMMENDATIONS

8.01 The project would develop about 37,000 ha under irrigation and would provide land consolidation, mechanization and a higher level of agricultural extension. It is an important part of the Korean Government's All Weather Farming Program and would contribute substantially to eliminating the country's deficit in foodgrains while increasing the production of higher value crops. The project is suitable for a Bank loan of US$ 45.0 million equivalent with a maturity of 30 years including 7 years grace. The borrower would be the Union of Land Improvement Associations (ULIA).

8.02 Among others, the following assurances have been obtained during negotiations:

(a) The government would not permit the upstream diversion of any water required for the project during periods of low river flow (para 4.04);

(b) The government, acting through the NACF, would give priority to the project area in the supply of inputs and in the allocation of credit funds and an annual plan for the distribution of the inputs and the provision of credit would be agreed between ULIA, NACF and the government (para 4.08);

(c) The government would construct the necessary power distribution facilities promptly and would at all times guarantee to supply the full power requirements of the project (para 4.09);

(d) No appointments would be made to the posts of director responsible for, or head of, SPAD without prior consultation with the Bank (para 5.07);

(e) As a condition of effectiveness of the proposed loan, ULIA would appoint for the duration of the construction period supervising consultants acceptable to the Bank and on terms and conditions acceptable to the Bank (para 5.10 and 5.11);

(f) A special coordinating committee would be established (para 5.12);

(g) ULIA would establish appropriate separate accounts for the project which would be audited annually by an independent auditor acceptable to the Bank (para 5.15); and

(h) Upon completion of the irrigation systems, water charges would be established in consultation with the Bank (para 5.18).

WATER SUPPLY

PYONGTAEK

Water Supply

Water supply for the Pyongtaek project would come from the Ansong Chong reservoir to be created by constructing a sea dike across the estuary at the mouth of the Ansong Chong. Two streams, the Ansong Chong and the Chinwi Chong having a total drainage area of 1644 km^2 drain into the reservoir. Stations to record inflow into the estuary were established under a UNDP program but review of the record indicates that the stations are subject to backwater from tidal action and are not reliable.

Review of rainfall records shows mean annual rainfall over the basin of 1300 mm. Extremes indicate that about once in 20 years the rainfall would be as low as half the annual or about 650 mm. The proportion of runoff to rainfall is relatively high in this basin because of the steep watersheds and the fact most annual rainfall is concentrated in a three-month rainy period. Very conservatively, if a runoff coefficient of 20% is used in a very dry year the inflow to the reservoir would be of the order of 220 Mm^3 which would be about three times the water required for the project area.

A portion of the project area, 4850 ha would be served by the Jangan pumping plant located on the Nam Yang reservoir to be created by completion of the Nam Yang sea dike. Drainage area tributary to the reservoir is 210 km^2 of which 40% is the reservoir itself. The runoff coefficient would be higher and in this case the very dry year inflow would be in the order of 60 Mm^3. Water can be transferred from Ansong Chong reservoir to Nam Yang through the irrigation system in the very rare event should it be necessary.

Irrigation Water Requirements

The cropping pattern for the Pyongtaek is:

Crop	Area (ha)
Early rice	3,100
Late rice	15,700
Fodder	100
Vegetables	800
Orchards	400
	20,100

Double cropping is practiced on the rice land as a winter crop.

Water requirements for each crop were computed by 10-day intervals using the Blaney Criddle method. Factors for k were based on experience in Korea and reflect farm irrigation efficiency of about 60%. The farm water requirements as computed for the ten-day intervals were then compared with

effective rainfall recorded in 1955. This year was chosen as it was the lowest rainfall of recent years. It was found that in many of the periods rainfall is adequate to meet the crop water requirements but that there was a small residual need for irrigation water in most periods and that in one period at the height of the growing season, all water requirements would have had to be supplied by irrigation. The capacity of the system has thus been sized to deliver 1.3 liters per second per ha which will satisfy requirements for water without rain.

Operation of Reservoir

The Ansong Chong reservoir would have a total capacity of 140 Mm^3 of which 80 Mm^3 is considered active in the range of water surface from elev 0 to 3.5 m. A study made for 1955 indicated that concurrent inflow to the reservoir would nearly satisfy the withdrawals to be made for irrigation and only 8 Mm^3 of storage was actually used. The total water required for irrigation for the year of study was 80 Mm^3 which is roughly 4000 m^3/ha. This amount with the rainfall was sufficient to meet the crop water requirements.

Adequacy of Supply

Although good records of inflow to the Ansong Chong and the Nam Yang are not available, there is ample margin of runoff into the two reservoirs to fully satisfy the irrigation requirement of the project area. This is particularly true in view of the large capacity of the two reservoirs compared to the irrigation demands.

Sediment

Based on an estimated effective erosion rate of 1 mm per year over 1644 km^2 drainage area the annual sediment inflow to Ansong Chong reservoir would be 1.6 Mm^3 per year. About one half of this amount would remain in suspension and pass through the reservoir and be discharged with the spills. Over 100 years the estimated sediment accumulation would be 58 Mm^3 which would not impair operation of the reservoir during its economic life.

Floods

The gate structure of the Ansong Chong and Nam Yang sea dikes must have sufficient discharge capacity to evacuate a design flood without raising the water surface elevation high enough to flood low lying lands along the reservoir. Lands which could be damaged are 1 m above the normal water surface of each reservoir, + 4.5 m elev in case of Ansong Chong and + 1.0 m in case of Nam Yang. For design purposes a storm having a recurrence interval of once in a hundred years was chosen. Such a storm would have a rainfall excess of 230 mm and the resulting floods would be:

	Ansong Chong	Nam Yang
Peak inflow	5000 m^3/sec	1000 m^3/sec
Volume	466 Mm^3	36 Mm^3

Routing these floods through the reservoirs indicates that the floods can be evacuated through the gate structures within a 48-hour period without exceeding the maximum allowable water surface.

Desalinization of Reservoirs

Both the Ansong Chong and Nam Yang reservoir basins are at present part of their respective estuaries and contain water nearly as saline as sea water (33,000 ppm). Before these reservoirs are useful as an irrigation supply the present saline water must be displaced by fresh. There will also be some leaching of salt from the underlying sediments which have been subject to inundation of saline water for many thousands of years. Under average runoff conditions and assuming a mixing efficiency of 75% it is estimated that after one year of operation the reservoir water would be about 1700 ppm salt and would be useable for paddy. By the end of the second season of operation, salt content should be below 700 ppm and useable for all crops. Continued operation should improve the situation to where ultimately the water in the reservoir should be only slightly more saline than the inflow which from samples averages less than 100 ppm dissolved solids.

KUMGANG

Water Supply

Water supply for the Kumgang project would come from the unregulated flow of the Kumgang River supplemented in low flow periods by releases from the Tapchang Reservoir located on the Nonsan Chou, a tributary of the Kumgang. The Kumgang River is the third largest in Korea with a drainage area of 8500 km^2 of which about 7200 km^2 is considered contributing to flows passing the project area. In an average year the flow is 4200 Mm^3 and in a dry year having a recurrence interval of once in twenty years about 1400 Mm^3. These flows far exceed in total the water needed for project purposes. However, the flows are highly erratic and reach their lowest point just prior to the onset of the rainy season.

Three pumping plants would pump water from the Kumgang. The plants are spaced along the river but all are at the head of the estuary and are subject to tidal influence. During extreme low flow periods the salt water fresh interface moves upstream and as the saline water reaches each pump site, pumping from the river will have to cease until the flow in the Kumgang increases to the point that the salt water interface is again moved downstream. During such periods water for irrigation would come from the releases from the Tapchang River to supply the areas served by the two lower pumping plants. Reservoir water cannot be supplied to the farthest upstream plant but the salt water penetration seldom reaches that plant.

A staff gauge was installed on the river at the upstream pumping station but because of the tidal effect records here are not meaningful. A station was established about 43 km upstream at Kongju in 1932 and records of flows are available since that time except for the World War II and Korean War periods. From this record and precipitation records 1955 was chosen for more detailed study as it represented the year of lowest runoff in the period for which dependable records are available.

From studies of analysis of water samples taken at various points along the Kumgang a correlation between positions of the salt water interface and the flows in the river was prepared which showed the salt penetration to extent up to the Yongduripuniping plant (existing plant farthest downstream) with flows of less than 15 m^3/sec to the vicinity of the Kongyong plant (middle plant) with flows less than 11 m^3/sec and to Pongjong (the highest plant) with flows less than 7 m^3/sec. The period of such low flows was then analyzed in detail for 1955 and it was found that the Yongduri plant would have had to cease operation for a 50-day period, May 10-June 30, the Kongyong from May 20 to June 30 and that the Pongjong plant could meet all project requirements until June 30. Releases from Tapchong Reservoir would be required in the magnitude of about 2.0 Mm^3 to firm up the supply during June.

Tapchong Reservoir was constructed in 1942 with an initial capacity of 24 Mm^3 to supply 600 ha in the Namsong Project. The capacity of the reservoir is now estimated at 21 Mm^3 due to siltation and it is proposed to raise the operating level by 1.7 meter to increase the capacity to 30 Mm^3 with the incremental 9.0 Mm^3 available to the Kumgang Project. The drainage basin tributary to the site is 218 km^2. The average year inflow is about 128 Mm^3 and the one in 20-dry year about 45 Mm^3. Since construction the reservoir has filled and spilled every year. It normally fills during the winter and starts spilling about December. There is adequate water to fill the reservoir to the enlarged capacity.

Irrigation Requirements

These were determined in the same manner as for the Pyongtaek project and total about 67 Mm^3 in a dry year. This is equivalent to 4400 m^3/ha.

Operation of Project

The annual flow of the Kumgang varies widely from year to year but the period of lowest flow access is usually about the first week of June and is believed the result of low flow at end of the dry season before the summer rains come and the use of water by upstream pumping plants. In nearly every year in latter part of May and early June the two downstream pumping plants would have to be staffed and the water supply would have to come from the Pongjong plant to the extent pumping these would not induce salt intrusion. Any amount not available from that plant would be supplied from the 9.0 Mm^3 of stored water from Tapchong Reservoir. By early July in all years for which records are available there has been sufficient rain to increase flows in the Kumgang and all pumping plants can operate without restriction.

Adequacy of Supply

The stored water in Tapchong Reservoir should be ample to supply project water requirements during those low flow periods when pumping from the river would be restricted. Tapchong water cannot be physically delivered to the primary service area (3550 ha) served by the Pongjong pumping plant. Under extreme low flows conditions estimated to be of about 10-15 days duration with a recurrence interval of 1 in 10 years this area could suffer some water shortage. This would occur at the transplant season and it is believed transplanting could be postponed until water is available without serious effect on yields.

Water Rights

Sixty-nine small irrigation schemes supply 32,000 ha primarily by pumping from the Kumgang are located upstream from the project area. The Government further has under consideration the Yongdom project which would involve storage and an out of basin diversion for hydro power and irrigation of 15,000 ha in the vicinity of Iri. There is more than ample water in total in the Kumgang to allow such a diversion and to fully satisfy existing upstre projects. However, any additional depletions which would take water during the low flow period when salt water encroachment is experienced would be detrimental to the project. Therefore, assurances would be needed that any future projects would be planned and operated so as not to further deplete flows in the Kumgang at critical low flow periods.

ANNEX 2

AGRICULTURE IN THE PROJECT AREA

A. Existing Agriculture

1. Pyongtaek and Kumgang have similar land use patterns. All valley land, whether irrigated or not, is occupied by paddy fields. The paddies in narrow valleys between foothills are terraced. On the broadside of the foothills, where the slope is gentle, are upland farms, orchards and village compounds. The upland fields are crudely terraced or not at all. Most of the orchards have some benching, some being more elaborate than others. Further up the hills and on steeper slopes, crops give way to woodlots, mostly pine.

2. Over this general landscape, scattered areas are already being irrigated by small LIA schemes previously completed. The Project Area therefore consists of numerous non-contiguous blocks of paddy fields with fringes of upland, cut up by hills and existing irrigation schemes. Such dispersion, however, provides a convenient opportunity to study the contrast between crop performances on rainfed and irrigated fields.

3. The main summer crop of the project area is rice. Only small portions of the paddy fields, mainly those in the narrow valleys, are planted to winter crops after the rice harvest; this is negligible in Pyongtaek and less than a quarter of the paddy area in Kumgang. The main summer crops on the upland fields are soybean, Chinese cabbage and sweet potato. The minor crops are sorghum, chillies, sesame and millet. The uplands are fully planted in the winter. On both paddy and upland, the dominant winter crop is barley. The present double cropping indices in Pyongtaek and Kumgang are 126% and 139% respectively.

4. The Pyongtaek project area is formed by parts of 6 counties (Gun) of two Provinces. The average farm holdings of these 6 counties is 1.11 ha, which is somewhat larger than the national average of 0.89 ha. The same for the 5 counties (also 2 provinces) related to the Kumgang project area are 0.92 ha. Since land reform (began in 1949), the great majority of the farmers have become owner farmers. Land tenure is no longer a constraint in Korea. Land consolidation has been carried out in nearby LIA irrigation schemes, but not in the project area. Having seen the improvement of crop yield on consolidated land, farmers generally welcome land consolidation.

5. Under the Office of Rural Development (ORD) of Ministry of Agriculture and Forestry (MAF), there are Research Institutes at the national level, experiment stations of the provincial level; and fairly well staffed extension offices (locally called Guidance Offices) at National, Provincial, County and District levels. Where LIA's are formed, they hire additional extension workers to serve member farmers.

6. The distribution of inputs (seeds, fertilizers, pesticides) and provision of institutional rural credit are the responsibilities of the National Agricultural Cooperative Federation (NACF) of MAF. The NACF has branch offices in each province and county and warehouses down to the district level. The entire cost of improved seed multiplication is borne by the Government.

Improved rice seeds are supplied by local cooperatives to farmers at the price of first grade paddy. Fertilizer is supplied with a small subsidy, at prices fixed by the Government; or if bartered with paddy, at fixed barter ratios. Pesticides are sold to farmers also at a slightly subsidized price by NACF. But under a program to encourage groups of farmers to adopt collective pest control over large areas, pesticides are supplied at half price to such groups organized either by ORD extension offices or by LIAs. Unlike fertilizers, which are sold solely by the Government, pesticides can also be bought from private dealers. When farmers buy inputs from NACF on credit, they pay an interest of 15% per annum. NACF now supplies about 30% of the total credit needs in the project areas; the balance is supplied by private sources at 50% per annum interest rate.

7. Use of improved seeds and fertilizers is already a common practice among Korean farmers for rice and barley; but much less so for other crops. The current average rate of fertilizer application on rice in Korea is about one-half of the rates recommended by ORD based on UNDP experiments, but in progressive LIAs area where land consolidation, irrigation and drainage are completed, farmers are already using fertilizers up to the level of ORD 1968 recommendations. Pest control, as one of the basic improvement measures, lags behind the extension of seeds and fertilizers in its effectiveness. The most prevailing pests seen on rice are rice blast disease, rice stem borer and barnyard grass as weeds.

8. Land preparation is done entirely by buffalo and hand, although a small number of power tillers have recently been introduced into Korea. Weeding, fertilizer application and harvesting are done by hand; pest control by hand sprayers or hand dusting; and threshing by foot-pedaled rotational threshers.

9. Rice yield on rainfed paddies averages 2 metric tons (MT) of white rice or about 3 MT of paddy in normal years, which compares favorably even with that of the irrigated rice in many Southeast and South Asian countries. Contrast with the much higher yielding irrigated paddies, however, reveals the potential of further significant yield increase. Twenty-two LIA's with a total paddy area of 12,258 ha (out of a total of 272 LIAs with a total paddy area of about 300,000 ha) have each reached an average yield of more than 4 MT of rice in 1966. Fields of all other crops except the Chinese cabbage (for making kim chee, a staple rural diet), are much less intensively cared for than rice fields. The yields are generally low.

B. Constraints on Crop Production Increase

10. The overall constraint in both Pyongtaek and Kumgang is the lack of controlled irrigation and drainage. Drought is the number one hazard. Late arrival of rain in May or drought spells in June would delay rice transplanting. Drought in July and August, when the water requirement of rice is at the peak, would reduce the number of heads per plant. It drought occurs in late August and September when rice is flowering and setting seeds, the yield is drastically reduced because of partially filled or empty grains.

Furthermore, the vicissitudes of the climate increase the risk associated with purchased inputs, especially fertilizer, and discourage their use in areas without controlled water supply.

11. On the other hand, heavy rain during summer months of normal years, coupled with poor drainage, cause overflow of rivers and canals and a general rice of the groundwater level; inundating the low land near the river mouth, along river banks and in low pockets on the valley bottoms. While the effect of the flashing floods is temporary, the continuous stagnant waterlogging of the low pockets checks rice growth, induces physiological diseases and reduces yield.

12. Furthermore, the slow drainage of the valley land in general leaves paddies too wet for plowing for planting barley immediately after rice harvest in mid or late October. If the sowing of barley is delayed until the latter part of November, a poor stand results from exposure of young seedlings to low temperature, frost and snow cover. Poor drainage is the main reason why most of the valley paddies are left in fallow during the winter. On higher and terraced paddies, farmers rush in barley sowing without adequate land preparation, except for the digging of shallow furrows about 4 feet apart to help surface drainage. Such extensive cultural practice results in low yields. The low yield and low price of barley and the fact that both the rice-harvest/barley-sowing and the barley-harvest/rice-transplanting have each to be completed within a short period of 10 days to 2 weeks making the planting of barley on paddy fields unattractive to most farmers except the most industrious ones.

13. On the upland, the main constraints are the lack of spring irrigation and the soil acidity (pH5-5.5), which is on the high side for the crops grown, i.e. barley, soybean, cabbage, potato, etc.

14. As mentioned before, the prevalence of rice blast disease is a matter of concern. Unless its control is made more effective, it will take a heavier toll of the bigger crop which could otherwise be obtained after the project.

15. Finally, the limited credit resources available to NACF (meeting only 30% of the present level need) are a constraint to the projected large increase in use of inputs as envisaged for the project area.

c. Means of Agricultural Development

Land Improvements and Development

16. The project area of 37,350 ha will receive land improvement treatments as follows:

	Land Consolidation and Irrigation (ha)	Terracing or benching and Irrigation (ha)	Benching without Irrigation (ha)	Reclamation and Irrigation (ha)	Total (ha)
Pyongtaek	10,750	4,500	1,600	4,850 1/	21,700
Kumgang	10,750 2/	4,260	500	140 3/	15,650
Total	21,500	8,760	2,100	4,990	37,350

1/ 4,400 ha. Tidal land, 350 ha. of salt farms and 100 ha. of depressions.
2/ 1,650 ha. of which have already been consolidated.
3/ Depressions.

17. The Land Consolidation Section of the Special Projects Administration Department of ULIA will carry out the planning, survey and mapping for land improvement work listed above with assistance from local LIA engineers. Contractors will do the actual field work. Contracts will be called on the basis of sample designs for about 10% of the total area. The size of the consolidated tracts will vary with topography, but will be around 0.3 ha in average. Appropriate number of these tracts will form irrigation unit of 5 ha. 2,100 ha of higher upland will be benched but remain non-irrigated.

18. The 4,400 ha of tidal land in Pyongtaek will undergo a 3-year period of desalinization by controlled leaching and drainage. This work can begin only after the completion of the irrigation and drainage systems. The 5 ha irrigation units will be developed as in rest of the project areas, but no consolidation is planned for the land is not fragmented to begin with. The disposal of the reclaimed land is pending government's decision whether the whole or part of the land will be managed by ULIA as large seed farms. Those to be allocated to farmers, if any, will have to be divided into tracts. The cost of such division is not included in the budget of this project.

19. Some 6,000 ha of the existing upland will be turned into paddy field by terracing and irrigation. Nearly 4,500 ha of wood land, with slope of from less than 9% up to 16%, will be cut over, plowed up, will be levelled and benched to provide new land for upland crops, orchards and pasture. The 2,100 ha which will remain non-irrigated after the completion of the project consists of the whole of the existing and new pasture land and a part of the existing and new orchards.

20. The farm development work thus involves the improvement of the existing 28,015 ha by consolidation, terracing and benching; reclamation and desalinization of 4,400 ha of tidal land; 590 ha of salt farms and depressions and development of 4,500 ha of low hills now under woodlots.

21. Providing each consolidated tract of paddy land with direct access to irrigation and drainage ditches, the latter connected to the project drainage system, is the basic improvement which makes projection of rice

yield increase and expansion of double cropping system possible. Benching and irrigation help to improve soil conservation, and increase yield of upland and orchard crops.

Increased Use of Inputs

22. The basic land improvement mentioned above will remove the drought hazard from nearly all project area and improve drainage of the valley paddy except the 4,700 ha of the bottom land. Unlike countries in South and Southeast Asia, all Korean rice are of Japonica varieties responsive to fertilizer application. With irrigation assured, Korean farmers are expected to readily increase the use of fertilizers.

23. The project envisages a significant increase in fertilizer application rates for all crops under irrigation. In rice, the per hectare application rates of N, P_2O_5 and k_2O are expected to increase by 100% from the present 60, 30, 30 Kg. respectively to 120, 60, and 60 Kg. at full development (year 8 in Pyongtaek and year 7 in Kumgang respectively). Similarly the corresponding rates for irrigated barley will increase from the present 40, 20, 20 Kg to 100, 80, 50 Kg per hectare at full development. The recommended higher rates for rice and barley are based on recommendations of the Office of Rural Development of MAF, which, in turn, are based on the field experimental results of the UNDP Soil Fertility Project, 1963-69. Supply of fertilizers to farmers in the Project Area at the recommended rates is not expected to be a problem.

24. ULIA will be responsible for making arrangements for supplying improved seeds to farmers in the Project Area. Whether the local LIA will supply seeds directly to farmers or make arrangements for NACF to do it will be decided by the Government later. If the latter course is taken, ULIA will propose variety, quantity and time of delivery. It is expected that rice and barley varieties with low yield but better tolerance against dry spells will be replaced by improved varieties with higher yield under assured irrigation. Equal attention will be paid by ULIA in supplying better seeds for crops other than rice and barley, which have been rather lax in the past. Farmers will propagate their own nursery trees for pears and peaches for the new plantings.

25. With gradual rise in crop yields and farm income, farmers are expected to increase their plant protection effort. Collective spraying is to be organized by ULIA over most of the Project Area, a task made easy by the forming of 5 ha irrigation units, and the introduction of high speed power sprayers. Special attention will be paid to protection against rice borer and rice blast disease, the twin major maladies of Korea rice today. The chemicals to be used for controlling pests on various crops have been worked out in Korea. New pesticides are continuously being tested and added to the list of extension. Supply of pesticides, currently through both NACF and private dealers, will not be a problem. In the Project Area, ULIA will propose kind, and quantity of pesticides needed, and make arrangements with NACF for timely delivery in lump quantities for use by farmer's groups organized for collective plant protection.

26. Two hundred 35-40 HP wheel tractors will be procured under the project. 100 will be allocated to Pyongtaek and 100 to Kumgang. They will mainly be employed to service valley paddies where rice and barley will be double cropped and the farm schedule is the tightest. Each tractor is expected to work from 750 to 800 hours in a year for land preparation, harvesting, liming and spraying of rice and land preparation and harvesting of barley. On the basis of main work performed, land preparation and combining, about 10,000 ha of rice and 6,000 ha of barley will be served. The tractor service is costed at an average of 1,000 won or $3.63 per hour. On basis of estimated working hours, it comes to approximately 11,100 won or $40 per ha for rice and 5,500 won or $20 per ha for barley. Even with tractor service, certain chores still have to be done by hand; such as nursery care, transplanting, fertilizer top dressing, irrigation and weeding of rice and fertilization, weeding and irrigation for barley. However, if the self labor is costed at 150 won and hired labor at 300 won per man day, the total labor cost per ha, including animal labor, of rice without tractor service will be about 50% high than with tractor service; and about 30% higher in case of barley. Limited by area that can be serviced by the 200 tractors during the 10 to 14 days between harvesting and planting of the two crops, about 20,000 ha of rice and 12,000 ha of barley grown on paddy land will not have tractor service until more tractors are brought in. The majority of farmers, therefore, will continue to depend entirely on animal and manual labor. With experience gained from operating these 200 tractors, the ULIA plans to buy more tractors later on with either Government funds or foreign loans.

27. Extension service personnel will be increased in the Project Area by the employment of new agricultural staff as a part of the new Special Project Administration Department and employment by the local LIAs to be organized in the Project Area. A gradual annual increase in the amount of inputs used per ha for various crops is projected for each year until the rates projected for the full development years are reached. Based on such phasing annual demonstration, education and training programs will be planned and executed by ULIA with the help of ORD and NACF.

Increase in Crop Yields

28. With the basic land improvement, increased use of inputs and strengthened extension service, significant yield increase is projected for all crops under irrigation, as shown in the report. Such yield projection is considered reasonable in comparison with existing yields obtained in countries with comparable conditions as well as past performance of more progressive local LIA where irrigation has already been provided.

PROJECTS WORKS AND CONSTRUCTION SCHEDULE

PYONGTAEK

The works consist of completion of the Nam Yang sea dike, construction of the Ansong Chong sea dike, primary and relift pump stations and an irrigation distribution system to serve 20,100 ha.

Nam Yang Dike. Construction of this dike was started as a private endeavor under license granted November 9, 1964. The licensee was to complete the sea dike by December 31, 1969 and reclaim 2530 ha for expansion of paddy field. The license is subject to cancellation if construction has not progressed according to schedule. The licensee has not put adequate resources into construction of the project and the Government has now decided to cancel the license and complete the work as part of the project. No retroactive financing of completed work is involved in the project.

The work remaining to be done is construction of the gated outlet structure and the closure of the deep water section of the dam. The wing dikes and excavation for the outlet structure are virtually complete. Total length of the dike is about 2.0 km of which about 900 m is now done. However, about 70% of the embankment quantity remain to be placed. The completion involves similar considerations as for the Ansong Chong dike.

Ansong Chong Dike. This dike across a narrow point of the Ansong Chong estuary would be about 3200 m long with a maximum height of fill of 18 m and crest width of 22 m at elevation + 8.5 m above mean sea level. The dike would be rockfill with a clay and loam fill on the land side. Slopes of fill would be 1:2 on the sea side with a 4.0 m berm at elevation 5.70. The slope on the land side would be very flat, 1:40.

The sluice or outlet structure would be founded on rock and contain 15 gates 10 m x 6 m. The sluice gate structure would be constructed in the dry by building a coffer dam around the site. A rock sill would be built up across the entire profile by dumping large rock from barges. Final closure will be made by dumping rock from a narrow gauge railway line during a period of neap tide with the gate structure open to help reduce the velocity of water over the sill. Once closure is effected the clay portion would be constructed and protected with rip rap. The tidal range is as much as 8 m and tidal velocities quite high. It is believed that before closure such velocities would be on order of 6 m/sec.

Dikes constructed under similar conditions have been completed in Korea and demonstrate the reasonableness of constructing the Ansong Chong and completion of the Nam Yang.

Pumping Plants. Pumping plant sites were chosen to have a suitable rock foundation where high ground lies immediately behind the site so the pump discharge line would be as short as possible. Each of the first stage pumping stations would deliver water to more than one main canal starting at

different elevations. The pump sets are chosen to match the varying capacities and lifts. First stage pumps would serve canals generally located at the 10 m level. Relift pumps or second stage would be built along the main canals to lift water to laterals at different elevations but generally at the 20 m level. Two third stage pumps would be used to lift water to the 25 m level.

All pumps would be electrically driven and would operate continuously for 24 hours a day during periods of peak demand. On an average, they would operate about 1000 hours a year. All pumps would be installed in permanent buildings. Living quarters for the operators would also be constructed.

Transmission lines to bring electric power to the pump sites would be constructed by the Korea Electric Power Company, and not be financed by the project. The Power Company would amortize the cost of lines through power revenues from the project and other customers who might be served.

Irrigation Distribution System. The canal system would have a capacity to deliver 1.3 liters/sec/ha to all areas served. The system would be unlined except for those sections where excavation during construction disclosed porous areas which justify lining to reduce losses. These are expected to be minor in extent.

The area to be irrigated is irregularly broken and intersected by ridges and hills. Some 47 short tunnels with an aggregate length of 6 km would be constructed. These would be concrete lined over the wetted part of the section. Where deep cuts are encountered a cut and cover section would be adopted so any slippage of material on the cut banks would not go into the canal. Canal structures as needed would be constructed of concrete. Turnouts would be a gated pipe outlet to each approximately 5 ha tract. The land consolidation to be carried out will provide a regular pattern of alternating irrigation farm laterals and drains to serve the individual holdings. Drainage outlets for surface water would be improved and obstructions removed. A controlled water surface elevation in Ansong Chong and Nam Yang reservoirs will improve drainage conditions on the low lying lands surrounding the reservoirs.

Access roads to pump sites would be constructed under the project. General improvement of the road network would be carried out under the regular budget of the Ministry of Construction. Access roads to individual holdings would be constructed as a part of the land consolidation work.

KUMGANG

The works consist of raising the operating level of Tapchang Reservoir, constructing primary and relift pumps and an irrigation system to serve 15,150 ha.

Tapchang Reservoir. The spillway at the existing dam would be raised 1.7 m by adding a concrete lift to the crest of the existing overflow spillway. To avoid raising the maximum water surface in the reservoir, siphon spillways would be constructed over a portion of the spillway to increase the discharge

capacity per meter of length of spillway crest. The spillway crest as modified would have the same discharge capability with the same water surface elevation as before the modification. The 1.7 meter increase in operating level would add 9.0 Mm^3 to the capacity of the reservoir and would be available for use by the Kumgang project.

Pumping Plants. Three pumping plants would provide the project water supply from the Kumgang River. The farthest upstream plant at Pongjong was sited at a relatively narrow reach of the river on the outside of a bend in the channel. The site was primarily chosen for its good foundation and the stable river channel condition which should insure availability of water even with low flows at the pump intake.

The middle station at Kanggyong requires a special arrangement on the intake so the supply to the intake can be drawn alternatively from the Kumgang, the canal from the Pongjong plant or releases from Tapchang Reservoir into the Nonsan Chong or any combination of those. A low dam and gate structure would be constructed to exclude Kumgang flows when that water is too saline. A siphon under the Nonsan Chong would feed water from the Pongjong pumping station to the intake. Suitable gates would be installed on the intake structure so water source can be selectively controlled.

The farthest downstream plant at Yongdu Ri is an existing plant and would be incorporated into the system.

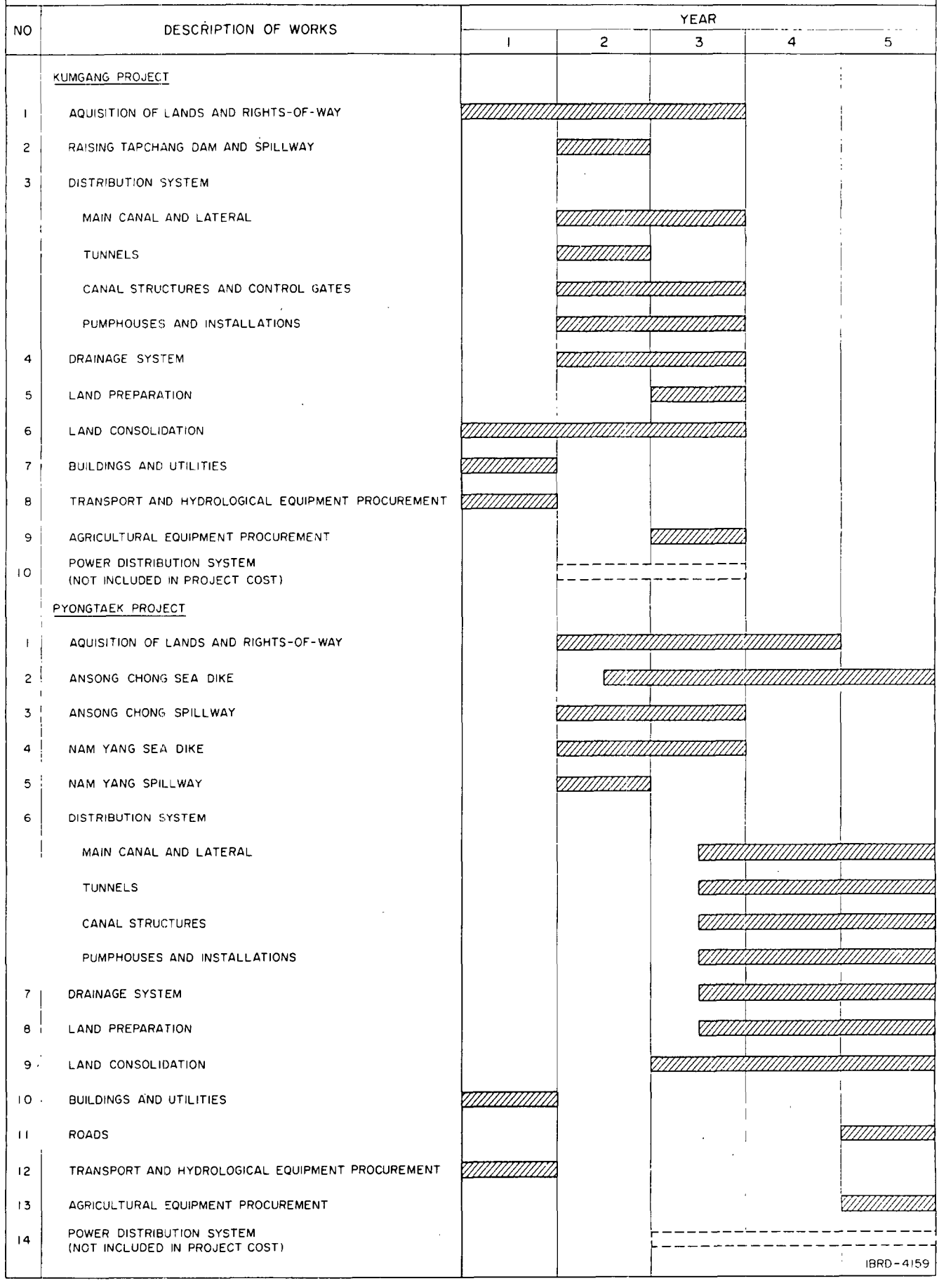
Canal system. The layout of the system is similar to that of the Pyongtaek project. The main additional feature is that a connecting canal would have sufficient capacity to transfer water from the Pongjong pump station to the Kanggyong station and from the Kanggyong plant to the service area supplied by the Yongdu Ri plant.

There would be one reach of canal on the discharge line from the Pongjong plant where because of the steep rock slope, a concrete bench flume would be required for a distance of about 2 km. Twenty-four short tunnels aggregating 1½ km in length would be required. Relift pumps would be constructed to serve the second stage canals.

Drainage. Surface drainage would be improved and two diesel driven pumps would be installed to remove flood water in low areas where natural outlets are not available. Diesel drive is chosen for these two stations as their use will be for relatively short periods each year and does not justify the additional investment in transmission facilities to bring in electric power.

Construction Schedule. The attached chart shows the construction schedule.

REPUBLIC OF KOREA: PYONGTAEK-KUMGANG IRRIGATION PROJECT
CONSTRUCTION SCHEDULE



Republic of Korea

Pyongtaek - Kumgang Irrigation Project

Cost Estimates

	Pyongtaek Area			Kumgang Area			Total			US$ Equivalent 1/		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
	(Won Millions)									(US$ Millions)		
Engineering Works												
Seadykes	2,060	1,317	3,377	-	-	-	2,060	1,317	3,377	7.4	4.7	12.1
Spillways	937	920	1,857	-	-	-	937	920	1,857	3.3	3.3	6.6
Distribution System:												
Canals	508	223	731	693	287	980	1,201	510	1,711	4.3	1.8	6.1
Tunnels	105	127	232	77	88	165	182	215	397	.6	.8	1.4
Structures	427	693	1,120	1,061	889	1,950	1,488	1,582	3,070	5.3	5.7	11.0
Pumphouses	116	365	481	121	342	463	237	707	944	.8	2.5	3.4
Drainage	32	-	32	53	40	93	85	40	125	.3	.1	.4
Land Preparation 2/	189	68	257	118	45	163	307	113	420	1.1	.4	1.5
Land Consolidation and Levelling	693	516	1,209	591	438	1,029	1,284	954	2,238	4.6	3.4	8.0
Raising Level of Tapchang Reservoir	-	-	-	21	45	66	21	45	66	.1	.2	.2
Acquisition of Right of Way	363	-	363	325	-	325	688	-	688	2.5	-	2.5
Construction of Buildings	17	-	17	14	-	14	31	-	31	.1	-	.1
Approach Road and Communications	8	4	12	66	17	83	74	21	95	.3	.1	.3
Miscellaneous	546	423	969	316	217	533	862	640	1,502	3.1	2.3	5.4
Total Engineering Works	6,001	4,656	10,657	3,456	2,408	5,864	9,457	7,064	16,521	33.8	25.2	59.0
Admin. Design and Supervision (10%)	600	466	1,066	345	241	586	945	707	1,652	3.4	2.5	5.9
Subtotal	6,601	5,122	11,723	3,801	2,649	6,450	10,402	7,771	18,173	37.2	27.7	64.9
Farm Machinery, Vehicles and Hydrological Equipment	-	232	232	-	288	288	-	520	520	-	1.9	1.9
Total Excluding Contingencies	6,601	5,354	11,955	3,801	2,937	6,738	10,402	8,291	18,693	37.2	29.6	66.8
Contingencies (20%)	1,320	1,071	2,391	760	588	1,348	2,080	1,659	3,739	7.4	5.9	13.3
Total Including Contingencies	7,921	6,425	14,346	4,561	3,525	8,086	12,482	9,950	22,432	44.6	35.5	80.1
Operation & Maintenance During Construction	294	52	346	634	34	668	928	86	1,014	3.3	.3	3.6
Subtotal	8,215	6,477	14,692	5,195	3,559	8,754	13,410	10,036	23,446	47.9	35.8	83.7
Seeds Project Preparation	-	-	-	-	-	-	7	41	48	- 3/	.2	.2
Interest During Construction	-	915	915	-	765	765	-	1,680	1,680	-	6.0	6.0
Grand Total Project Cost	8,215	7,392	15,607	5,195	4,324	9,519	13,410	11,757	25,174	47.9	42.0	89.9

1/ Columns and rows do not necessarily add correctly due to rounding off.
2/ This includes clearing, grubbing, terracing and benching of upland areas prior to the construction of irrigation and drainage facilities.
3/ Less than $50,000.

ANNEX 4

ANNEX 5

K O R E A

Pyongtaek-Kumgang Irrigation Project

Items to be Procured by ULIA

(Cost in US $ 000's)

1.	Electric pumps	1,480
2.	Diesel pumps	80
3.	Sluice gates	1,600
4.	Electrical and mechanical equipment for sluice gate operation	1,890
5.	Tractors and implements	1,650
6.	Insecticide sprayers	160
7.	Cement	2,070
8.	Reinforcing steel	670
9.	Wood for shuttering	800
10.	Vehicles and hydrological equipment	220
11.	Miscellaneous equipment	660
12.	Training fellowships	50
13.	Foreign exchange cost of consultants	2,000
	Subtotal	13,330
	Contingencies (20%)	2,670
	Total	16,000

ANNEX 6
Table 1

KOREA

UNION OF LAND IMPROVEMENT ASSOCIATIONS

Statement of Revenue and Expenditure
for the Year ended December 31, 1967
(Won millions)

Revenue	
Membership dues of LIA's	28.2
Government grants:	
General operations	794.9
Tidal reclamation projects	718.6
Rental of heavy equipment	121.7
Supply of construction materials	257.3
Miscellaneous revenue	1.9
Total	1,922.6
Expenditure	
Supervision of construction, surveying and design of land improvement works	667.9
Special account for tidal reclamation	718.6
Operation of heavy equipment	107.7
Purchase of construction materials	258.0
Welfare projects	28.2
Administrative costs	129.7
Miscellaneous costs	2.7
Total Costs	1,912.8
Net Revenue	9.8

Note During the year the following sub-loan transactions occurred:

Short term loans : disbursements	479.8	
repayments		11.8
Long term loans : disbursements	1,477.2	
repayments		671.1
Net increase in assets and liabilities		1,274.1
Total	1,957.0	1,957.0

ANNEX 6
Table 2

KOREA

UNION OF LAND IMPROVEMENT ASSOCIATIONS

Comparative Balance Sheet as of
December 31, 1967
(Won millions)

	1966	1967
Assets		
Current Assets	325.6	352.0
Work in Progress	146.1	270.8
Sub-loans to LIA's	7,125.8	8,399.9
Fixed Assets	1,958.8	1,905.2
Total Assets	9,556.3	10,927.9
Liabilities and Net Worth		
Current Liabilities	278.6	205.4
Borrowings for Sub-loan Operations	7,125.8	8,399.9
Liabilities	1,275.8	1,193.3
Depreciation Reserve	172.2	268.2
Building Fund	118.7	265.9
Total Liabilities	8,971.1	10,332.7
Accumulated Surplus	585.2	595.2
Total Liabilities and Net Worth	9,556.3	10,927.9

K O R E A

PYONGTAEK-KUMGANG IRRIGATION PROJECT
PRESENT AND PROJECTED AGRICULTURAL PRODUCTION

Commodity	Present			Projected (Full Development)		
	Cropped Hectares	Production ('000 m.tons)	GPV 1/ (Mill. Won)	Cropped Hectares	Production ('000 m.tons)	GPV 1/ (Million Won)
Rice (white)	21,178	46.26	1,943	31,850	127.46	5,353
Soya (beans)	3,176	1.90	53	1,630	2.06	58
Sweet Potatoes	2,240	28.30	226	1,080	17.30	138
Chinese Cabbage	1,070	13.60	122	1,050	24.10	217
Barley (clean)	8,243	11.43	194	20,960	49.01	833
Cabbage	-	-	-	5,500	136.50	1,502
Fodder (Rye)	-	-	-	4,200	84.00	168
Potatoes	796	4.72	71	-	-	-
Flax	-	-	-	250	0.75	17
Pears	173	1.29	39	1,650	18.00	540
Peaches	173	1.01	20	1,650	12.90	258
Pasture Crops	93	1.86	4	100	3.00	6
Total	37,142	110.37	2,672	69,920	475.08	9,090

1/ Gross Production Value (GPV) figures rounded and valued at following price per metric ton: 42,000 won for rice, 28,000 won for soya (beans), 8,000 won for sweet potatoes, 9,000 won for chinese cabbage, 17,000 won for barley, 11,000 for cabbage, 2,000 won for fodder, 15,000 won for potatoes, 23,000 won for flax, 30,000 won for pears and 20,000 won for peaches.

ANNEX 7

ANNEX 8

ECONOMIC TRENDS IN THE KOREAN FOODGRAIN MARKET

In the past 20 years much progress has been made in improving and expanding Korea's agriculture. Although Korea is a food-deficit country, its farmers are now supplying more food to a population that has nearly doubled since 1948. Food consumption has increased more than food production in the last 20 years mainly because of an increase in population (especially as a result of the influx of refugees from North Korea); increasing urbanization and rising per capita incomes. From the decade 1957 to 1967 farm-crop production has fluctuated but with an upward trend. The increase has averaged about 4.2% annually. Currently the estimated per capital daily food intake of South Koreans exceeds 2,400 calories, compared with 2,200 calories in 1961, which was already a substantial improvement over earlier years.

A. Trade in Grains

Despite the expansion in domestic agricultural production, Korea has, as Table 1 indicates, been increasingly depending on food imports for meeting its food deficits. In 1967 these imports were valued at approximately US$ 76 million or about 86% more than in 1962 (about US$ 41 million). The increases have occured mainly in wheat, wheat flour and barley (until 1963) and are obtained mainly from the United States of America under Public Law 480, used largely for payment of wages in kind, and some commercial imports. USDA estimates that about 10% of the food presently consumed in Korea is imported.

Until 1966 Korea made substantial progress in closing her foodgrain gap. The gap measured by net imports as a percent of total supplies increased to a peak, in 1963, of 22%. From 1963 to 1966 the gap narrowed to about 7%. In 1966 net foodgrain imports had declined to 477,000 m tons. However, in 1967 and 1968 the gap widened to 14 and 17% with net foodgrain imports increasing to 1,100,000 and 1,200,000 m tons respectively. The increase imports in 1967 were due primarily to exceptional demands created by the National Assembly and Presidential elections plus the availability of favorable 35-month term commercial credits for grain imports. The 1968 increases are due to shortages of domestic supplies (of 312,000 m tons) due to the drought and accelerated consumption (approximately 400,000 m tons) resulting primarily from the decision of the Korean Government to keep the price of grain, especially rice, low to urban consumers. This gap will be filled by PL 480 and commercial imports.

Recent studies conducted on the agricultural outlook for Korean indicate that (i) farmers respond positively to price increases for rice (ii) the demand for rice by urban consumers is relatively price inelastic but (iii) demand is relatively elastic for the quantities farmers hold for their own use. Thus a properly formulated grain price policy, particularly for rice, can have the greatest quantitative impact on grain production and consumption in the shortest possible time. If, on the other hand, current consumption and production trends continue during the remaining period of the Second Five-Year Plan, US-AID studies show that there will be an overall foodgrain gap between 1.6 to 2.0 million m tons in 1971.

B. Price Trends

There has been a continuous upward trend, since 1956, in prices of agricultural products generally. In 1967 the index of prices received by farmers (1960 base) realized 313.2. Grain prices (particularly Rice, Barley, Wheat and other cereals) increased at a faster rate than prices of all commodities up to 1964. They then suffered a setback but the index recovered in 1967 to 285.3 points for rice and 282 points for barley. The index of prices paid by farmers has shown a constant upward trend since 1960 reaching 295.7 points in 1967. On an aggregate basis, the parity index below indicates that prices received by farmers have been rising faster than prices paid. This suggests that, overall, prices have been an incentive for increased agricultural output over the last several years.

Index of Prices Received and Paid with Parity Ratio (1960 = 100)

Year	Prices Received	Prices Paid	Parity Ratio (%)
1960	100.0	100.0	100.0
1961	115.9	112.0	103.5
1962	131.7	124.2	106.0
1963	186.9	149.9	124.7
1964	231.6	201.9	114.7
1965	255.8	234.0	109.3
1966	268.0	256.2	104.6
1967	313.2	295.7	105.9

Following the land reform of 1950 and with the growth in development of the Korean economy and the growth in market orientation of the Korean farmer, prices have come to play a greater role in both resource allocation and income distribution. However for prices to work effectively as a resource allocator and income distributor in agriculture, there must be an excess of production over farmer needs that is available for commercialization (or selling in the market). Although Korean agriculture is becoming more commercialized it is still far from a market-based agriculture. As the table below indicates, Korean farmers in 1966 sold 50% of their rice crop, 30% of their barley crop. Furthermore it is estimated that nearly 100% of silk cocoons produced; nearly all of the fruit crop, but much smaller quantities of the corn, vegetables, soybeans and other grain crops were marketed.

Rates of Commercialization of Rice and Barley Crops

	Rice	Barley
1958 crop	48.5	24.5
1959 "	44.9	24.4
1960 "	31.0	13.8
1961 "	34.0	18.4
1962 "	35.6	19.1
1963 "	36.2	15.6
1964 "	47.8	13.7
1965 "	48.9	29.2
1966 "	50.0	30.0

Source: NACF Research Department Files.

If major farm inputs are readily available at low costs and favorable farm product prices are maintained, this rate of commercialization can be expected to continue increasing especially with the relative expansion of the non-farm population and the Government's aggressive policies to find export markets for Korean agricultural products.

The Korean farmer is inclined to respond to changes in input and output prices in his production decision. This was demonstrated well in 1963 when farmer response to production of sweet potatoes, at prices quoted in advanced by Government, exceeded the Government's budgetary capacity to purchase sweet potatoes. Thus, with Korean agriculture becoming more market oriented and monetized, favorable relative prices could provide a stimulus to increased agricultural production.

C. Grain Price Policies

The Government has regulated the grain market through a managed supply program, including regulated imports and support purchases of domestically produced grain. This program has operated satisfactorily in achieving the objectives of acquiring grain for Government consumption purposes and stabilizing seasonal variations in rice and barley prices.

The primary objective of the Korean Government's pricing policy is to stabilize the prices of supplies to farmers and final goods to consumers. An important tool recently established for accomplishing these objectives is the Farm Produces Price Stabilization Fund, which can be operated to provide stable year-to-year food supplies. This fund was created to help stabilize the prices of products and can be used for farm products whose prices are abnormally low or high as designated by the Minister of Agriculture. If prices are low, purchases are made in the market and, if high, existing stocks are released or commodities imported.

Past operation of the Grain Management Supply (GMS) Program has benefited farmers to some extent although it has been more beneficial to consumers, particularly through price stabilization releases of rice in the Seoul and Pusan markets at prices substantially under free market prices and below the real cost of acquisition, storage and holding costs. Thus urban consumers have been subsidized by taxpayers to the extent that deficits in the GMS program has been covered by budgeted funds. The level of rice price in Korea is a policy variable of the Korean Government. Through operation of the GMS and other programs the Korean Government can, within limits, manipulate the price of rice to the benefit of the farmer or the consumer.

The Korean Government appears to have recently modified its grain policy, which hitherto had maintained rice purchases and sales at prices relatively low to other crops (and also lower than those prevailing in the world rice markets), by announcement (Korea Times, October 9, 1968) of its decision to increase Government's:

(a) purchase price of polished rice by 17% 1/ over last year's price (for the 570,000 metric tons of rice it will purchase from farmers in 1968 to maintain as reserve stocks and supply to its Defence Forces) to increase farmer income and encourage increased rice production of about 87,000 metric tons of rice in the following year's output;

(b) sales price of Government-held rice by about 14% 2/ to the general consumer in an effort to discourage consumers from eating more rice-confined meals;

(c) efforts to keep the prices of other grains low relative to rice in order to widen the gap between prices of rice and other cereals and change consumption patterns away from rice to wheat and other cereals.

D. The Second Five-Year Plan

Self-Sufficiency in agriculture is one of the basic aims of Korea's Second Five-Year Development Plan (1967-71). The Plan envisions a substantial and ambitious development of the rural sector of the Korean economy. Specifically the goal for the agricultural sector is to obtain self-sufficiency in foodgrains by 1971. In 1967 and 1968 growth projected for agriculture (5% annually) met a reversal due especially to adverse weather resulting in a drought which reduced rice production in the South and the Government's decision to keep the price of grain low to urban consumers.

It would not have been possible to achieve self-sufficiency in foodgrains under the Second Five-Year Plan with the Government's existing policies. The pattern of deficits and surpluses existing in the last two years did, however, suggest to the Government the need for measures to curb the consumption accelerated by its policy of keeping low grain sales and purchase prices, especially for rice. In order to prevent an overall foodgrain gap of about two million metric tons occurring by the end of the Second Five-Year Plan (1971), drastic changes in price policies for foodgrains were announced on October 9, 1968. These new policies are expected to result in:

(a) higher prices for rice sales and purchase that will curb rice consumption increases (shifting consumption to barley and wheat) while stimulating its production;

1/ This will raise the purchase price of an 80 kg bag of polished rice to 4,200 won.

2/ Price per bag of 80 kg polished rice will be around 4,700 won, which is expected to defray production, storage, handling and other costs.

(b) relatively lower prices for barley 1/ that would encourage consumers to shift consumption patterns from rice to barley; uncover the latent demand for it and clear the market at lower price levels.

By the end of the Second Five-Year Development Plan (1971) it is expected that, with other appropriate policies and programs and assuming normal weather conditions, foodgrain self-sufficiency will be achieved. This self-sufficiency would be a net foodgrain self-sufficiency characterized by wheat imports, rice exports, and substitution of domestic barley for some imported livestock feed grains.

1/ Korean barley prices have remained at levels above world market prices for much of the year.

TABLE 1: Trade in Grains, South Korea, 1959-1968

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968 1/
	in '000 metric tons									
Imports										
Rice	3.8	-	-	-	118.4	-	-	31.5	112.6	216.0
Barley	31.6	-	189.8	47.1	263.5	225.9	106.3	-	-	-
Wheat	133.4	348.7	329.6	377.1	778.8	545.4	441.0	339.7	873.6	804.0
Wheat Flour 2/	39.0	31.9	18.4	20.7	26.6	61.8	54.8	118.7	35.4	N.A.
Others 3/	N.A.	87.4	65.2	54.1	157.3	81.9	67.0	35.0	78.7	223.0
Total Foodgrain Imports	207.8 4/	468.0	603.0	499.0	1344.6	915.0	669.1	524.9	1100.3	1243.0
Exports										
Rice	5.0	24.2	5.8	62.0	5.7	14.0	19.2	44.0	-	-
Others	N.A.	0.8	2.2	2.0	0.3	N.A.	5.8	4.0	4.0	N.A.
Total Foodgrain Exports	5.0 4/	25.0	8.0	64.0	6.0	14.0 4/	25.0	48.0	4.0	N.A.
Net Imports of Foodgrains	202.8 4/	443.0	595.0	435.0	1338.6	901.0 4/	644.1	476.9	1096.3	1243.0 4/
Domestic Production	4539.0	4440.0	5025.0	4551.0	4654.0	5898.0	5713.0	6080.0 1/	6528.0 1/	6216.0
Total Supply of Foodgrain	4741.8 4/	4883.0	5620.0	4986.0	5992.6	6799.0 4/	6357.1	6556.9	7624.3	7459.0 4/
Annual Rate of Increase in %	3% 4/	15.1%	-11.3%	20.2%	13.5% 4/	-6.5% 4/	4.7%	16.3%	-2.2% 4/	
Ratio of Net Imports to Total Supply for all Foodgrain	4.3% 4/	9.1%	10.6%	8.7%	22.3%	13.3% 4/	10.1%	7.2%	14.4%	16.7%

1/ In terms of Rice Years (November 1, 1958 to October 31, 1968). Data obtained from USOM.
2/ Used essentially for Relief and Military Assistance.
3/ Includes cereals and cereal preparations, also corn.
4/ Does not include figures on items for which data are not available.

SOURCE: Ministry of Agriculture and Forestry, Yearbook of Statistics 1968 and data obtained from USOM.

ANNEX 8
Table 1

K O R E A

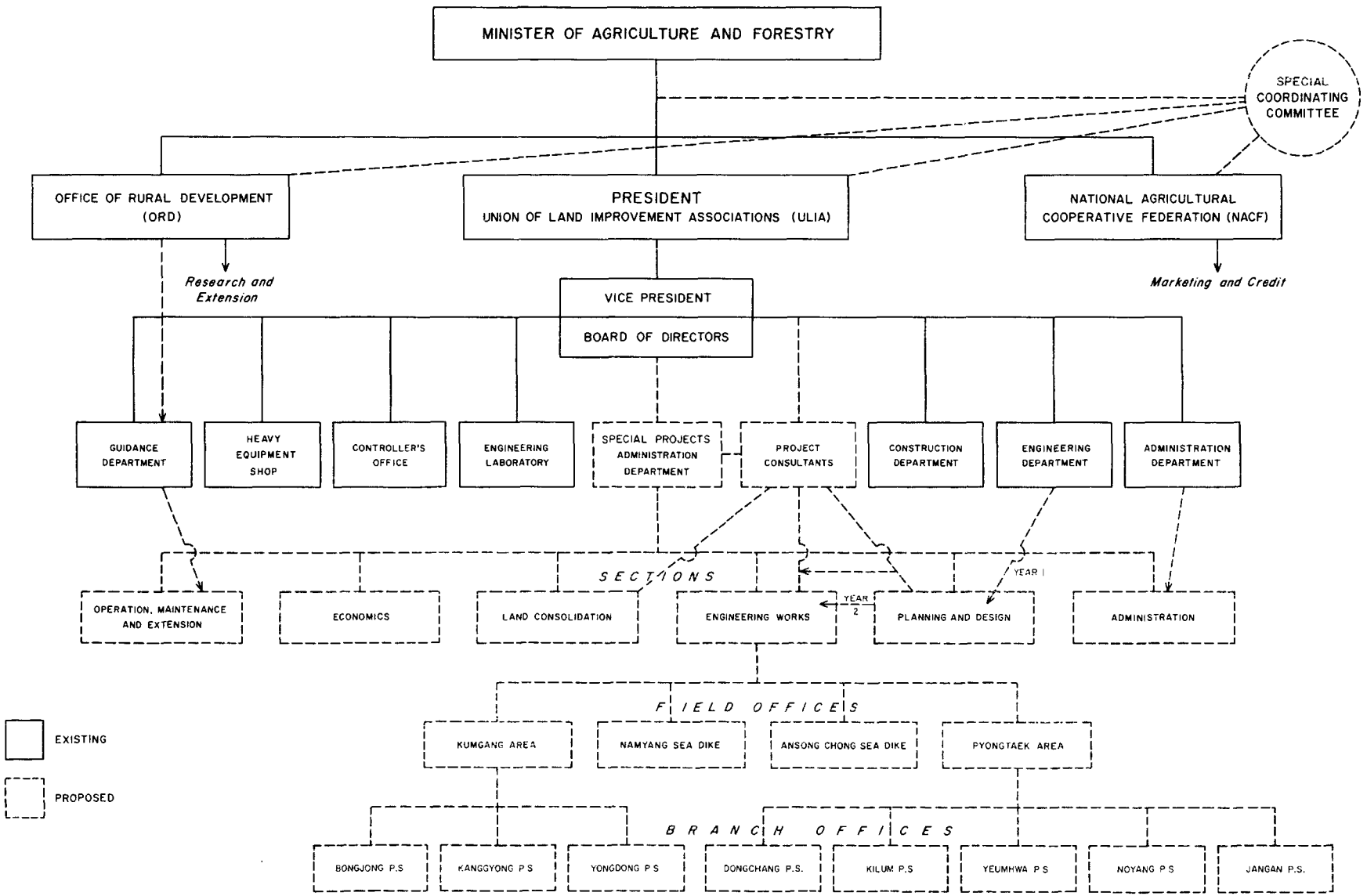
PYONGTAEK-KUMGANG IRRIGATION PROJECT
ECONOMIC RATE OF RETURN
(All amounts in ₩ million)

Year	Gross Production Value	Cost of Production	Net Production Value	Incremental Net Production Value from Project Operation	O & M Costs 1/	Incremental Project Benefits	Capital Costs of Project	Rate of Return Discounted at 13.8% Benefits	Rate of Return Discounted at 13.8% Costs
1	2,673.0	1,031.0	1,642.0	-	13.3	- 13.3	1,424.0	- 11.7	1,251.3
2	2,673.0	1,031.0	1,642.0	-	55.2	- 55.2	6,214.0	- 42.6	4,798.3
3	2,673.0	1,031.0	1,642.0	-	90.1	- 90.1	7,662.3	- 61.1	5,198.9
4	3,650.0	1,326.0	2,324.0	682.0	415.3	266.7	4,100.6	159.0	2,444.6
5	4,454.0	1,602.0	2,852.0	1,210.0	440.6	769.4	3,198.0	403.1	1,675.6
6	7,015.0	2,361.0	4,654.0	3,012.0	532.0	2,480.0	-	1,141.8	
7	8,616.0	2,712.0	5,904.0	4,262.0	532.0	3,730.0	-	1,509.1	
8	9,090.0	2,788.0	6,302.0	4,660.0	532.0	4,128.0	-	1,467.8	
9	9,090.0	2,788.0	6,302.0	4,660.0	532.0	4,128.0		1,289.6	
↓	↓	↓	↓	↓	↓	↓		↓	
								9,332.0	
↓	↓	↓	↓	↓	↓	↓		↓	
60	9,090.0	2,788.0	6,302.0	4,660.0	532.0	4,128.0	-		
								15,187.0	15,368.7

1/ Includes sinking fund for replacement of vehicles (5 years life expectancy) and pumps (30 years life expectancy). Also includes cost of agricultural extension.

ANNEX 9

REPUBLIC OF KOREA: PYONGTAEK-KUMGANG IRRIGATION PROJECT
PROPOSED ORGANIZATION CHART

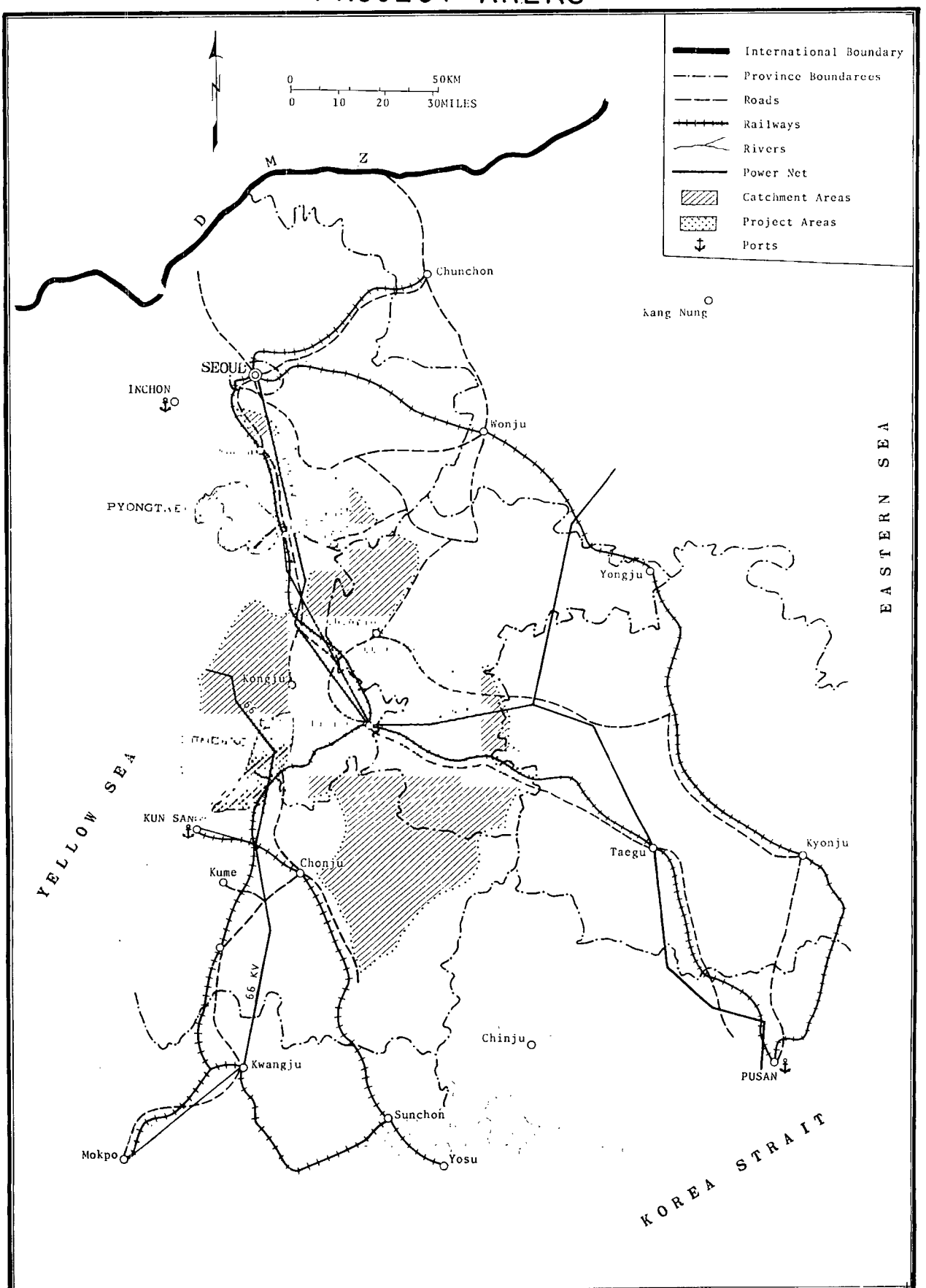


February 1969

(R)IBRD-4160

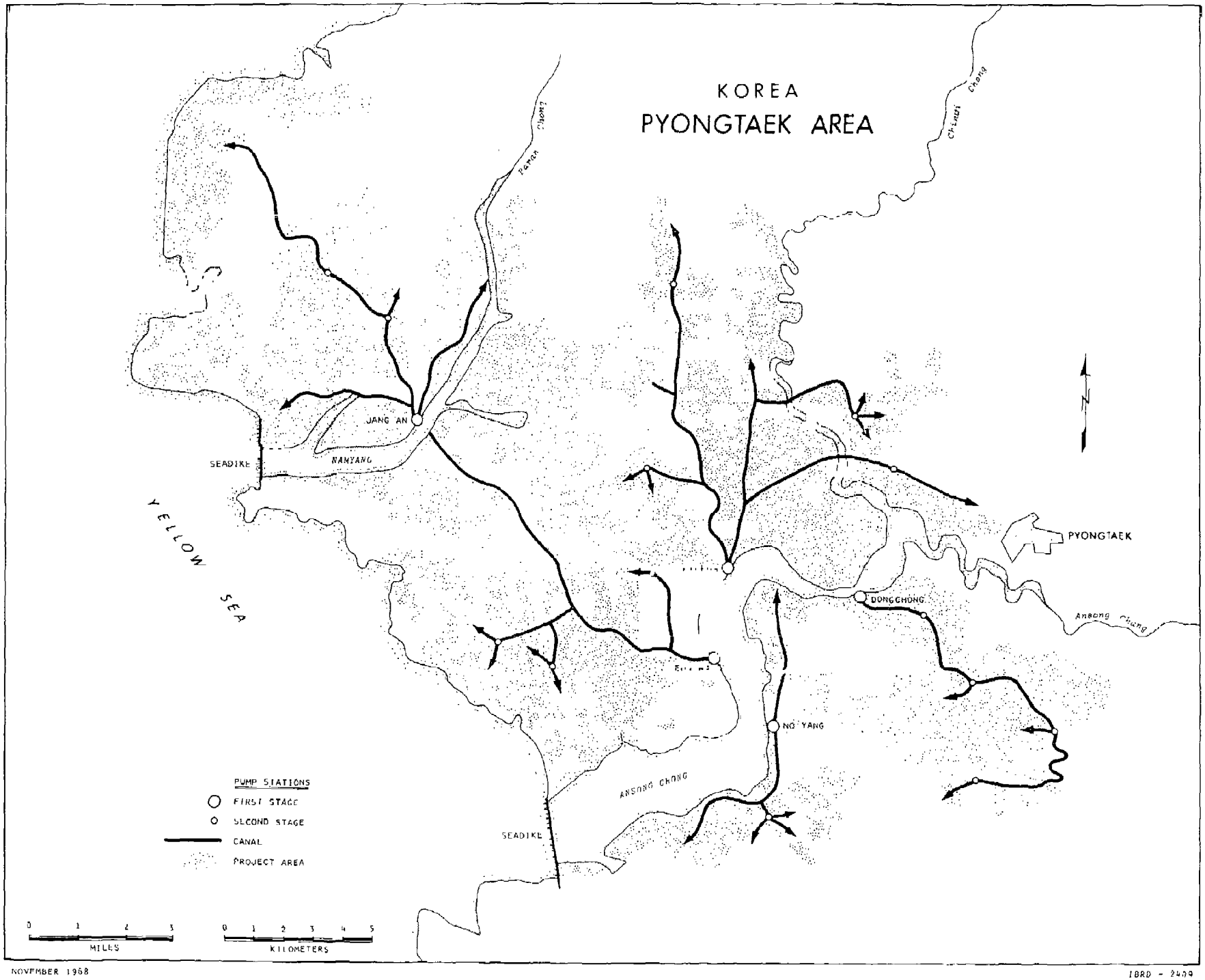
ANNEX 10

KOREA
LOCATION OF PYONGTAEK AND KUMGANG PROJECT AREAS



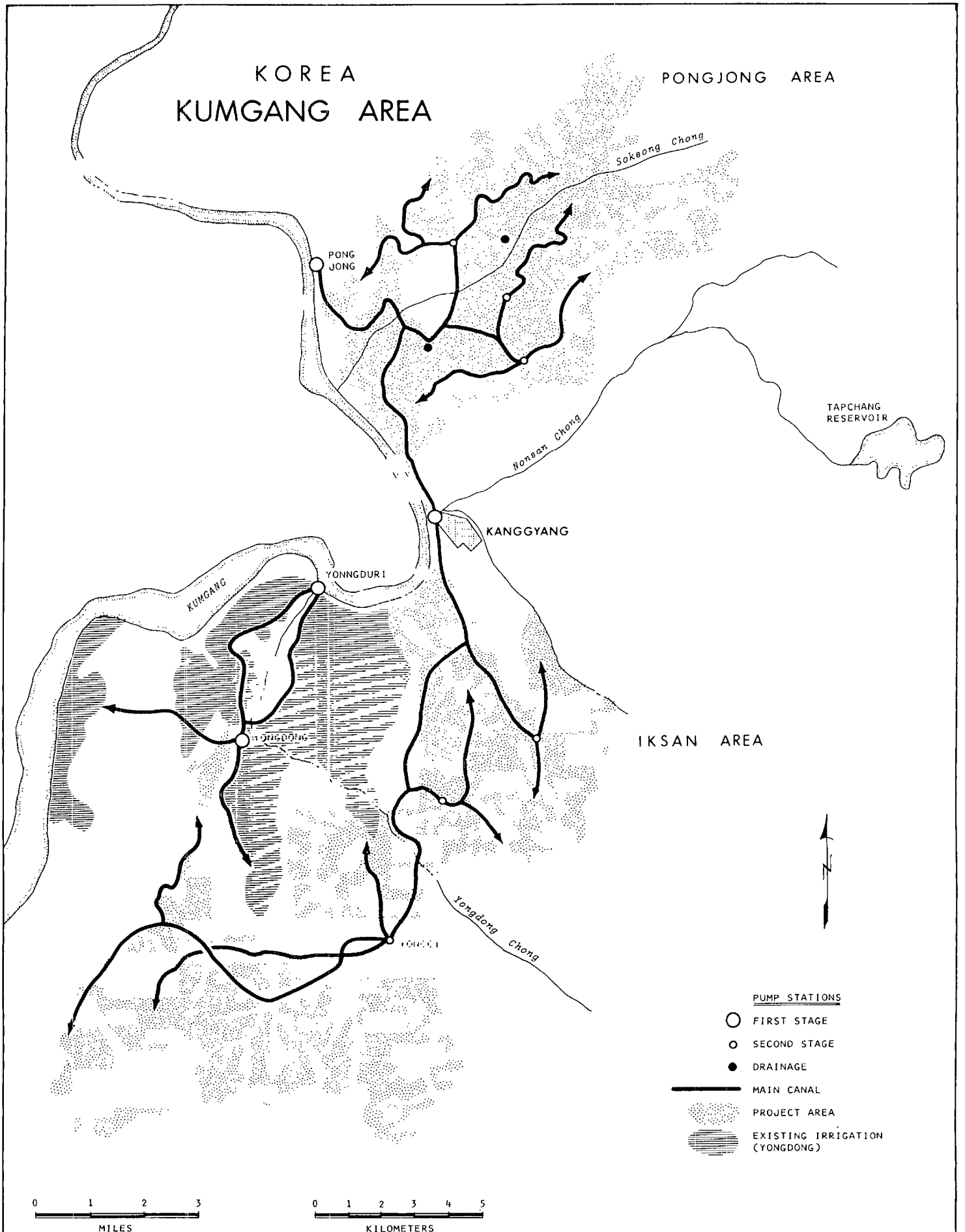
NOVEMBER 1968

IBRD 2408



NOVEMBER 1968

IBRD - 2459



NOVEMBER 1968

IBRD - 2410